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Cab Signals and Stops.

SAFEGUARDING RAILWAY operation has always been one of the vital questions since its institution, and many attempts, strung over a long period of time, have been made to devise an apparatus which will automatically stop a train, or give a direct and forceful indication to the engine driver in the cab. During the last six years there has been particular activity along this line, and it is safe to say that hundreds of devices, either for automatic stops or cab signals, have been brought out, though very few have survived an actual practical test. The essential feature of such a device is that it shall be reliable to a very high degree, operating under any and all conditions. If it be not so, its development represents a misapplication of time and money.

German roads have been experimenting with a great many devices during the past few years, the majority of which are electrically operated from below—that is, by contact or induction from a shoe or rail on the roadbed. The greatest drawbacks to these devices are that the contact brush becomes damaged by ballast and obstructions near the rails, and as the shoe or treadle is connected in with the signal mechanism, there is considerable trouble during the winter months, due to its becoming clogged with snow and ice. Numerous experiments have also been made with wireless control, but there is at present much uncertainty due to the proximity of telegraph lines, bridges and signal poles.

One device of a strictly mechanical nature has been tried—a shoe striking against fixed treadles alongside the rail, thus releasing a spring in the cab and giving a signal or operating the air brakes as may be desired. The treadle on the roadbed being movable, of course, lays it open to difficulties in the winter. A method which has met with considerable favor abroad consists of a fixed treadle near the home signal, arranged to give an alarm in the signal tower every time the signal is overrun. This gives a check and in case of frequent overrunning the cause for it is investigated. Up to the present, however, none of the German systems have proved exceptionally successful. Most of the devices worked out in this country have in general been along similar lines to those abroad, although they have not as yet been given as thorough a trial. An example of an entirely different type, however, is the Harrington train stop, which operates at the top of the engine, i. e., a suspended weight strikes a rod projecting from the top of the cab and by its inertia moves the rod and causes a service application of the brakes. Apparently a system operating from above would have a number of advantages over a system operating near the level of the roadbed. The problem is in the transference of the energy to the cab; whether it then be used to set the brake or to throw on a light and ring a bell in the cab, is a matter which can easily be settled as thought best.

In foreign countries the general practice is to have it operate a cab signal, while in this country the tendency is to have it automatically set the brakes. It would seem that an automatic train stop, if generally adopted, would take a certain amount of responsibility from the engineer and would cause him to be less careful, depending on the stop

to carry the responsibility. On the other hand, with a signal in the cab, he would know that he alone was responsible, that no hand could operate the throttle and air brake equipment but that of the man in the cab.

Signal systems and methods on our American roads perhaps are not perfect, but they have been developed to a point where they are very efficient in protecting train operation. On account of the distance between the signal and the engine man for whom it is intended, it is inevitable that they should occasionally prove ineffective. Therefore if indicating these signals in a visible and audible way just in front of the engineer in the cab is feasible, it would help to reduce the chance of error, especially during bad weather, to a minimum. But considerable experimentation must still be done in order to perfect a device which has that prime requisite, reliability.

New Grades.

ATTENTION IS being called to the improper construction of sub-grades in the past, which has resulted in soft spots developing causing the railways much trouble and expense. At the annual meeting of the Roadmasters and Maintenance of Way Association the subject was discussed at length, one member advocating that the expense of compacting the grade with a steam roller, was justifiable in order to make the grades better. One of the worst phases of the subject has not been considered however. Many miles of grade at the present time are made by putting up a temporary trestle onto which the filling is hauled and dumped. These trestles may be comparatively light and for use of small dump cars and dummy engines. Or the trestle may be made for standard railway equipment. The filling which is dumped off around these trestles will not fill in closely around the trestle timbers unless good dry gravel or sand is used. Generally the filling is more or less lumpy soil. The effect of this construction, especially on a high grade, is that many hollow places are left close to the temporary pile structure when filling. Out in the slopes the filling is not so loose. The result is that after the grade is completed the center settles much more than the shoulder, and the grade will become very seriously pocketed. This defect in the grade is increased by very lumpy material which leaves greater voids and greatly increases subsequent settling.

If the tracks on the new grade were not ballasted for some time, there would be a chance to correct this fault to some extent by putting in more filling as the grade settled. It is usual, however, to keep ballasted up as close to the track layer as possible, in order to have a faster and safer track for construction trains. Where the center settles the pockets are filled with the ballast. Water which permeates to these pockets in the sub-grade is prevented from quickly being drained out of the embankment by the shoulder of the sub-grade, which is higher than the center and more impervious to water than the ballast.

Recent tests on ballast have shown that a layer of cinders about sixteen inches deep under the ballast will take up a large amount of water and gradually dispose of it so that very little will reach the sub-grade. Gravel also will produce the same effect but is not as good as the engine cinders.

It is to be hoped that results of actual experiences will soon be available to inform us as to whether the use of a good thick coat of ballast overlying a cushion of cinders or gravel will compensate for poor grade construction, or whether methods at present being used in such work will have to be modified or abandoned in order to get desired results.

Specifying Material.

THERE IS SOMETIMES timidity among subordinates about requesting certain makes of tools, materials or appliances, which they may have good reason to believe would decrease costs or promote efficiency. To show the attitude of one manufacturer we reproduce the following from *Power*:

You may remember the story of the engineer who knew a lot about power plant engineering practice. He was a careful reader of the reading columns and advertising pages of his paper. He kept catalog files and interesting information and figures on plant equipment.

That was his trouble—he *kept* them.

One day the manager said to him: "Here's something new that looks pretty good to me, what do you know about it?"

"Why I know a lot about it," replied the engineer. "Only last night I was telling my wife how we could make good use of that here."

"Telling you wife!" exclaimed Mr. Manager. "What in blazes has she got to do with it? She doesn't run this plant. Why don't you come to me? I don't want to run a back-number plant and I'm depending on you as the power specialist to keep me informed."

The engineer went back to the engine-room with a new idea. He sat on it long enough to hatch out something that's been with him ever since—to his everlasting benefit. He has learned that knowledge without *action* is like a motor boat without gasoline—you don't get there.

He has also learned that he can suggest things to the management without being accused of "butting in."

The manager of the power plant above may be likened to an officer of a railway. He must depend to a large extent on his subordinates to study out and suggest or specify improvements or economies in the details. And by doing that the subordinate not only increases his efficiency, but draws attention to himself as a progressive employe. It is a frequently expressed truth that the man picked out for promotion is not the man who does only that which he is paid for, but the man who does more than he is paid for. No employe should hesitate to investigate and then to recommend or specify materials which would result in increased efficiency or economy.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.

The American Bridge & Building Association will hold its annual meeting at St. Louis, Mo., October 17-19, inclusive. The following subjects will be reported on by the committees: (1) Fireproofing frame and pile trestles; (2) Derricks and other appliances for handling material in supply yards; (3) Best method of numbering bridges; (4) Arrangement of depot and platforms for small towns, as to convenience and appearance; (5) Sash—size and kind of glass for roundhouses and shops; (6) Best and most economical pumping engines; (7) Records of bridges, buildings and other structures from the time of construction; original cost and maintenance; (8) Concrete tank construction; (9) Brick veneer for station buildings; (10) Roofs and roof coverings; (11) Embankment protection.

WINNIPEG UNION STATION.

The recently completed union station at Winnipeg, Man., was built for the Canadian Northern Ry., the Grand Trunk Pacific Ry. and the Transcontinental Ry. These three roads also participate in the use of a new freight house and yards. The new terminal adjoins the site of old Fort Garry, which was built in 1822, and was the beginning of the present city of Winnipeg.

The terminal covers an area of about twelve acres, formerly occupied by engine houses, car and machine shops and storehouses of the Canadian Northern. These were replaced by new facilities installed at the general railway yards of the company about a mile west of Main street; the street the new station faces. In addition to the territory obtained by removing these buildings, the railways purchased the remainder of the property between Main street, Water street and the Red and Assiniboine rivers, which made a total of about 70 acres available. The location of the rivers restricted the extension of the yards in two directions, and this caused some difficulty in the plans.

The design of the general plan and all details of the new terminal were entrusted to Warren & Wetmore, architects, of New York City. They were instructed to make a layout, using the total area of the property, disregarding all the existing facilities, even the river bridges.

The through station layout was adopted, as a stub end layout, such as was first contemplated, would have made the distance between the necessary wye track (from the yard lead to the passenger tracks) and the station at least one-half mile, thereby rendering impossible the efficient operation and dispatch of trains during busy periods; also causing a large increase in the time for trains to reach the terminal station, due to the long backup.

The station building is located on Main street directly opposite Broadway, as required by an agreement with the city. The building in addition to providing all facilities for passengers, contains offices for the railway service. In anticipation of large increase in the future requirements for offices, provisions have been made for their future extension, by the addition of six stories.

The building is of stone and has a length of 350 ft. along Main street, and a width of 140 ft. The height of the greater portion of the building is three stories and a basement, with an elaborate central portion having great arched windows on all four sides, and surmounted by a dome 100 ft. above the street level. The main entrance is at the center of the building on Main street, beneath a great stone arch.

The main floor is at street level. In the center is a rotunda and ticket lobby, a circular space 90 ft. in diameter unobstructed by columns, seats or booths. Ample light is given this rotunda through the windows in the dome. The waiting room occupies the north wing. The exit to trains is at the back of the lobby, directly opposite the entrance door, and opens into a subway under the tracks which leads to the train platforms. The waiting room, being separate, is free from confusion and disorder, and for this reason serves the convenience of waiting passengers most effectively. The floor area is 9,000 sq. ft., and is set with movable oak benches, which give a large seating capacity. Adjoining on the east are wash rooms, and on the west is a restaurant and lunch room, which also has a direct entrance from the street.

Winnipeg Union Station.

The interior of the waiting room and ticket lobby has been given the effect of stone construction throughout; the wainscoting is of marble 6 ft. high, and the floors are of terazza. This construction is attractive, and is also easily cleaned and sanitary. All stairways are of iron with marble treads.

The basement floor is 15 ft. below the level of Main street. The entire south wing of this floor is given over to emigrants. There is a waiting room, with a lunch counter on the north side, a laundry, separate men's and women's bathrooms, men's smoking rooms and a women's waiting room. A separate entrance and exit is provided for emigrants to station and trains so that they need not come in contact with other

passengers. In the north wing of the basement floor is a barber shop, a kitchen for the restaurant, and the boiler and engine rooms.

The basement being below ground level, the entire building is surrounded by a retaining wall which provides an open area-way approximately 10 ft. wide, and gives light and air to the basement. The retaining wall is of reinforced concrete, with a reinforced concrete pier opposite each of the steel columns of the building. Between the reinforced piers are concrete slabs 16 ins. thick, reinforced with twisted steel rods laid horizontally. The elevation of the basement floor is 7 ft. below high water in the Assinboine river, and for this reason the retaining wall was waterproofed, as was also the concrete basement floor. The waterproofing consists of 5-ply felt and tar beneath the floor, and on the back of the retaining walls.

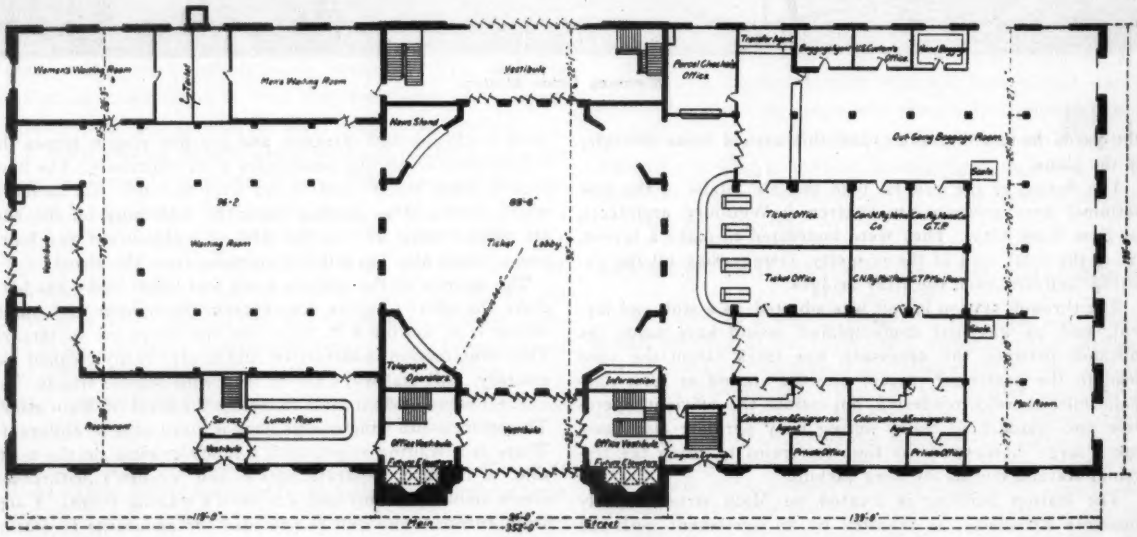
The second and third floors of the station are occupied by local and general western offices of the railways. Part of the offices face into a corridor, and the interior offices face the open central court. Each floor provides 25,000 sq. ft. for offices, exclusive of corridors ,stairways, elevators and toilets. Provisions were made in the designs for an addition of six office floors.

The structure is of the steel skeleton type with 150 columns. The columns are supoprted on piles, designed to carry a load of 35 tons each. The soil is wet quicksand to a depth of 35 ft., unlaid by rock; 2,500 tamarack piles were used, with a specified loading of 25 tons. These piles were driven to bed rock. The cut-off being practically at high water level of the nearby river, it was figured that wooden piles would last practically as long as concrete. A test load of 70 tons was balanced on the butt of one pile, which had been driven to refusal, bringing up on hardpan a distance of 35 ft. below the level of column footing. This load was carried by the pile for a period of two weeks without any settlement whatever.

The columns all have I-shape cross sections, made with a solid web plate and four flange angles reinforced with cover plates when necessary. The maximum column load is 1,292,000 lbs. and the corresponding cross section area is built up with four 6x4x$\frac{13}{16}$-in. flange cover plates. The lower sections of the columns, about 37 ft. long, extend through the basement and first story, and the second sections, which extend through the second, third and fourth stories, each of them 12 ft. 8 ins. high, are about 38 ft. long, excepting under the dome, where some of them are about 50 ft. long. The third, or fourth story sections are 12 ft. 8 ins. long.

Corner of Main Waiting Room, Winnipeg Station.

Columns with heavy loads have extended bases, distributing them across the full width of I-beam grillages, seated on concrete footings with pile foundations. The base plates, 1-in. thick, project considerably beyond the column flanges and are reinforced by extended wing plates riveted to the column flanges and by stiffener angles on the wing plates. The grillage beams are entirely enclosed in concrete, which is extended up to cover the base plates of the columns.



Floor Plan, Winnipeg Station.

The grillages for the heaviest loads are made with four 36-in. I-beams, and those for smaller loads are made with three 24-in. I-beams. The grillages are set on rectangular concrete footings, reinforced by horizontal old rails just above the tops of the foundation piles. The heaviest column loads have 16 piles for their foundations, those with the 24-in. grillage beams have nine piles, and the lightest column loads have only two piles; the columns in the latter case are seated directly on the concrete footings without the interposition of grillage beams.

With the exception of a few of the wall columns, which are especially grouped for architectural considerations, and a few of those in the dome construction, all columns are located at the intersection of longitudinal and transverse lines from 18 ft. 7 ins. to 23 ft. apart, thus affording advantageous lengths of floor panels and making very regular beam and girder construction. Excepting some box and plate girders in the second floor, which are introduced to carry offset upper story sections of the columns and to span extra long distances between columns, all of the girders are made with single or double I-beams 18 or 20 ins. deep, and all of the floor beams are single I-beams, most of them 12 inches deep.

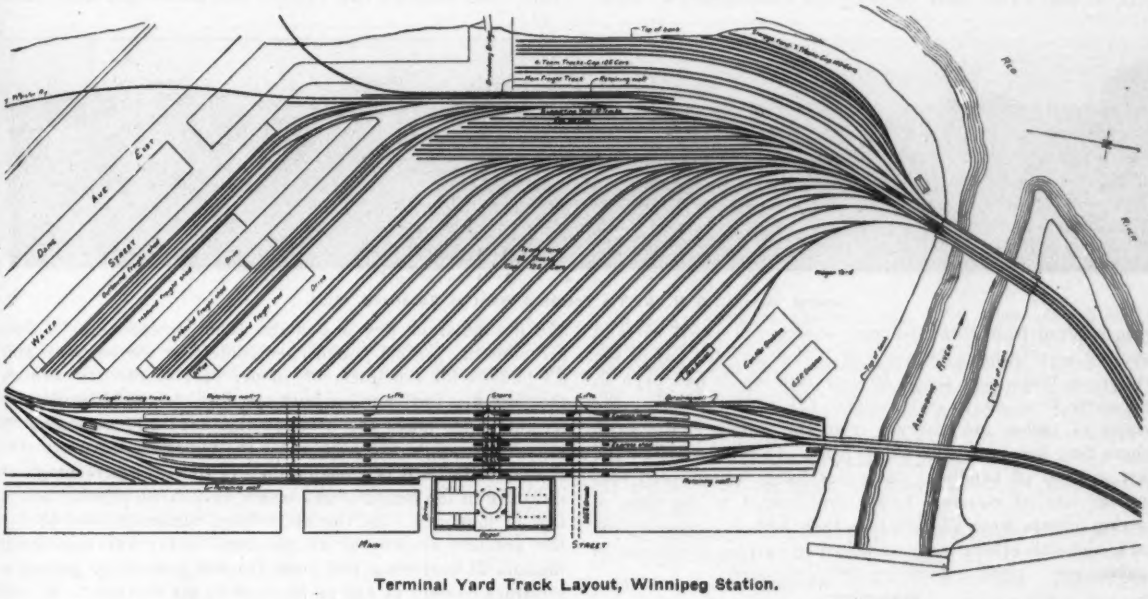
The dome framing is made with 12 radial trusses, which are supported on columns at the lower ends, and at their upper ends are connected to an octagonal frame-work of vertical trusses, which transmit the balanced reactions across the 30-ft. open central space. Intermediate trusses are similar to the main trusses except that they are somewhat shorter and of lighter construction, and are supported at their lower ends on horizontal trusses, which connect the dome columns. The radial trusses both have skeleton framework extensions above their top chords to carry the rafters and curved purlins of the convex dome roof. These extensions cantilever beyond the inner ends of the trusses to carry the octagonal framework 19 ft. in diameter for the center monitor. I-beam purlins in the dome are spaced about 6 ft. apart and support a continuous reinforced concrete roof slab 3 ins. thick, which is waterproofed and covered with flat tiles.

The new track construction in the west approach starts from the old main lines on the north bank of the Red river about 2,000 ft. west of Main street, on an ascending 0.4% grade. The track crosses Main street on a double track plate girder bridge with a clearance of 14 ft. above the street. The Assiniboine river is spanned by a new double track steel truss bridge 400 ft. in length, one span of which is a draw. The east approach starts from the present main line near St. Boniface Station, and ascends on a 0.4% grade to the Red river, which is crossed on a new double track steel truss bridge 900 ft. in length with one draw span.

The passenger station track layouts are operated from signal towers, the installations being of the electro-pneumatic type. The track is 80-lb. steel, with gravel ballast.

The railway officials who co-operated in the construction of the terminal are: William Mackenzie, president; Sir Donald Mann, vice-president, and H. H. McLeod, general manager, of the Canadian Northern; Chas. F. Hayes, president, Frank W. Morse, vice-president and general manager, and B. B. Kelliher, chief engineer, of the Grand Trunk Pacific; and the Commissioners of the National Transcontinental, S. N. Parent, chairman.

We are indebted for the above information and illustrations to Mr. J. D. Matheson, engineer for Warren & Wetmore, architects, New York.



Terminal Yard Track Layout, Winnipeg Station.

According to reports, plans have been made by the Central Vermont for building a passenger station and eliminating grade crossings in Burlington, Vt., at a cost of about $315,000.

The New York Central & Hudson River has applied to the Board of Estimates of New York City for the right to gridiron West street, from the Battery to Fifty-ninth street, with an elevated structure to cost $43,000,000, and to build bridges and viaducts at the intersecting streets along its Park avenue right of way, to cost $22,000,000.

The Great Northern and the Oregon-Washington R. R. & Navigation Co. have completed the new 1,000-ft. reinforced concrete viaduct on Fourth avenue in Seattle, Wash. The viaduct extends from Jackson street to Seattle boulevard and costs about $300,000.

Arrangements have been perfected by the Santa Fe system with the city of Dallas, Tex., for the construction of a viaduct across the tracks at either Chestnut or some other nearby parallel street.

PRESERVATIVE TREATMENT OF HEMLOCK AND TAMARACK TIES.*

Hemlock and tamarack ties ordinarily last only about five years. Hence in order to derive the greatest service it is necessary to treat them with some preservative. For this purpose the Chicago & Northwestern Ry. erected a treating plant at Escanaba, Mich., in 1903. Previous to that time very little hemlock and tamarack had been treated. Both are unusually difficult to impregnate, because of the density of their wood; and the best method of handling had not been determined. It was even contended that the resistant character of the wood made all forms of preservative treatment impracticable. In the spring of 1905 a cooperative experiment was undertaken by the U. S. Forest Service and the Chicago & Northwestern Ry., i norder to find out what results were being obtained at the Escanaba plant, and, if possible, to devise methods for bettering the treatment. Preliminary experiments and analyses of treated ties of both species showed that the wood failed to absorb the desired amount of the preservative and that most of the absorption was confined to a narrow exterior layer.

The total number of ties selected for the experiment was 8,214, of which 4,574 were hemlock and 3,640 tamarack. These were secured from three different sources: (1) 3,547 cut and received in monthly allotments in 1905-6; (2) 100 cut in the winter of 1903-4 and taken from a raft which had been in the water from six to eight weeks; (3) 4,567 cut during the winter of 1905-6 and reserved from the supply in the yard, where they had been received in April. In order to show the best method of handling, these ties were redistributed into smaller lots or classes. Some were peeled at the time of cutting, others were allowed to season without removing the bark, and still others were subjected to various conditions of soaking.

General View, C. & N. W. Tie Treating Plant at Escanaba, Mich.

Seasoning.

At the experimental treating yard all ties were piled in isolated groups, with tiers arranged on three different plans —7 by 7, 7 by 2, and 8 by 1. In the ordinary seasoning yard, where economy of space and labor require that the piles shall be close together and that there shall be about twenty tiers to each pile, the conditoins are wholly different. The circulation of the air is largely shut off from the interior piles, and the sun reaches only the ties in the upper tiers; hence it is important that an open pile be used. The 7 by 2 pile proved the most satisfactory and has been adopted by the management of the treating plant.

The rate of seasoning is influenced chiefly by the structure of the wood and by climatic conditions. A wood may be open-grained and porous, and thus permit rapid evaporation of the water in its cells, or it may be dense and impervious. In this first class are such quick-seasoning species as loblolly pine, western yellow pine, and arborvitae; in the second, hemlock and tamarack. The close-grained structure of both of these greatly retard evaporation, and in hemlock especially there is a tendency to season only a thin and irregular surface layer, which thus forms a protective covering over the interior wood. Climatic conditions in the northern peninsula of Michigan are somewhat unfavorable. During five months of the year, November to March, the average temperature is almost constantly below the freezing point. Furthermore, during practically the entire winter the ground is covered with snow, which by melting retard loss of moisture from the wood during the periods when the temperature is above the freezing point. In this climate, therefore, the seasoning period is limited to about seven months, April to October.

In the experiments on treating it was found that hemlock and tamarack ties can be successfully treated when they have been reduced in weight by seasoning to 40 and 42 pounds, respectively. The objects of the experiments in seasoning were to find the best methods of handling the ties so as to bring them to this condition and to see what influence various methods of seasoning might have upon the absorptive qualities of the timber.

Near the close of the experimental work at Escanaba, weights and volumes were taken on a number of hemlock and tamarack ties which had been cut in the winter of 1903-4 and consequently had passed through two full seasoning periods. The hemlock ties weighed 30.6 pounds per cubic foot and the tamarack ties 39 pounds. The corresponding moisture contents are 6.6 pounds per cubic foot for hemlock and 8.4 pounds for tamarack, or, in per cent of the dry weight, they are 27.5 per cent for both species. At the time the last weights were taken the hemlock ties were still seasoning at a low rate, while the weights of the tamarack ties were stationary. Hence it is probable that, in time, the percentage of moisture in the hemlock ties would have fallen slightly below that of tamarack. On the other hand, tamarack loses by far the greatest amount of its moisture during the first three months of seasoning and soon reaches practically as low a moisture content as can be attained by air drying.

Treating.

Because of the many points on which information was desired and the comparatively limited supply of material available it was impossible to work with only one variable at a time. However, in order to avoid confusion in presenting the conclusions excerpts have been made of all data which bear upon the point in question.

The effect of air seasoning before treatment may be expected to manifest itself in two general ways—first, in the amount of the preservative absorbed by the timber and, second, in the diffusion of the preservative throughout the interior of the wood. The diffusion may take place while the preservative is being injected, or through osmotic and capillary forces during the seasoning of the timber after treatment. These points will be considered separately.

In July, 1905, two tramloads of mixed hemlock and tamarack were included in a regular run at the treating plant. Tramload No. 1 was made up of ties from lot 1, which had been seasoned four months without removing the bark. Tramload No. 2 was composed of ties from lot 2, which had been soaked for six or eight weeks, and then seasoned for twelve months with the bark and for an additional two months after it had been removed. Each tie in the two loads was weighed before and after treating and again

*U. S. Dept. of Agriculture, Circular 132.

at intervals of five hours, and five, forty-two, sixty-nine, and one hundred and sixty days after treatment .

The results noted from this experiment were:

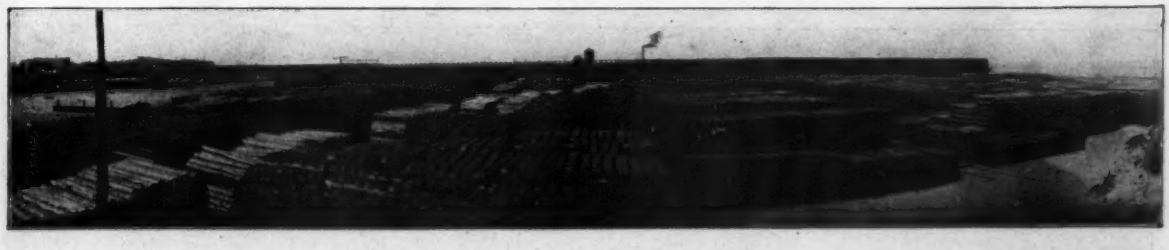
(1) The wide variation and low average in the absorption of the preservative by the ties in tramload No. 1.

(2) The comparative uniformity and high average of the absorption of the preservative by the ties in tramload No. 2.

(3) The great amount of water, in excess of that taken on during treatment, lost in subsequent seasoning of the ties in tramload No. 1 as compared with the ties in tramload No. 2.

(4) That the ties which gain least during treatment show the heaviest loss in the subsequent seasoning, thus giving evidence of their relatively greater moisture content before treatment.

The conclusions drawn are that the moisture content of the timber has a strong influence on the amount of the preservative which the wood absorbs, and that before a satisfactory treatment can be secured the timber must be approximately air dry. The weight per cubic foot which indicates that this condition has been approached varies with the species and the climatic conditions. However, it is clear that for a climate such as prevails in the northern part of the Lake States hemlock can readily be seasoned down to a weight of 40 pounds and tamarack down to 42 pounds per cubic foot within a year after cutting, and if properly handled, in four or five months.



Tie Storage Yard, C. & N. W. Escanaba Plant.

Diffusion of the Preservative.

Although the success or failure of any treatment is measured primarily by the amount of the preservative absorbed, a factor of scarcely less importance is the extent to which the preservative is diffused throughout the heartwood and sapwood in all portions of the timber. This is especially true in timbers in the form of cross-ties.

The fact that it is the face of the tie which is subjected to spiking and rail-cutting makes it very important that this portion of the tie at least should receive a thorough impregnation with the preservative. The round sides of the tie are protected by a layer of porous sapwood which absorbs the liquid readily, and it often happens that these portions of the tie may be thoroughly saturated while the adjoining heartwood shows no absorption whatever. Hence it is that the absorption of the preservative, considered alone, is not a certain criterion of the success or failure of a particular treatment. It may happen that some ties have a greater proportion of sapwood, or that the sapwood in some ties absorbs more of the preservative per cubic foot than in other ties. However, from the large number of analyses which have been made in connection with the present experiment, it has been established that there is a close relation between the total amount of the absorption and the diffusion of the liquid throughout the interior of the tie. It is only natural to expect that under certain conditions the liquid diffuses more widely throughout the interior of the tie, and that this result can be brought about more rapidly in thoroughly seasoned ties than in those in which the moisture in the wood structure presents a mechanical resistance to the diffusion of the preservative. The analysis of over 100 ties to determine the diffusion of the preservative throughout the interior portions of the timber confirms this theory, proving that in general a given amount of the preservative is more equally distributed in the ties which had been allowed to become air dry before treatment.

With the exception of the comparatively small number of hemlock ties which are peeled in the woods, all ties for commercial treatment are brought to the treating plant before their bark has been removed. In this condition they are piled to season, and the bark is not taken off until they are ready for treatment. To peel the ties before seasoning involves an additional expense of about 2 cents per tie. In order to find out whether this expense is justified, a comparison was made between peeled and unpeeled ties of both hemlock and tamarack. During the seasoning period it was found that the peeled hemlock ties lost moisture more rapidly than those not peeled, and at the end of October weighed 36.8 pounds per cubic foot as compared with 40.9 for the unpeeled ties. Peeled tamarack, on the other hand, was slightly heavier before treatment than were the unpeeled ties.

In every instance the ties that were seasoned with the bark show an increased absorption over ties of the same class which had been peeled before seasoning. Despite the fact that in most cases the unpeeled ties have a slightly greater moisture content than the peeled ties, the experiment shows that the difference between the absorptive qualities of the two classes of timber is great enough to overcome the tendency of the drier wood to absorb the preservative more readily.

The difference in the absorption for hemlock ties of the two classes varies from 0.8 of a pound per cubic foot to 6.6 pounds, a total difference of nearly 6 pounds. This difference is much wider than in the case of tamarack. Indeed, in tamarack it is so slight that it matters little whether or not these ties are peeled before seasoning.

It is plain that the bark should be allowed to remain on the hemlock ties during seasoning. This is opposed to experience with other species, and may be explained as due to a casehardening, which takes place when the moist wood under the bark is suddenly exposed to the direct action of sun and wind. The shrinking and hardening of the fibers tends to form a comparatively impervious layer over the surface of the tie, which considerably retards the penetration of the preservative.

Two results are to be drawn from these considerations:

First. It is immaterial whether tamarack ties are peeled before or after seasoning. It has already been stated, however, that to peel before seasoning necessitates extra expense, and it is therefore recommended that the peeling of the ties be deferred until they are being prepared for treatment.

Second. That all hemlock ties should be seasoned without removing the bark.

With ties designed for treatment during the winter months

an exception to the above conclusions must be made. The low temperatures prevailing at that time cause the bark to adhere firmly to the wood, rendering its removal difficult and costly. Hence it is recommended that a sufficient number of ties be peeled during the summer to afford a supply for winter use.

Although these experimental runs failed to produce conclusive data, they indicate that one hour's steaming is too short and that three hours is too long. Therefore, the present custom of steaming for two hours should not be altered, and the pressure should be maintained as long as is warranted by the rate at which the solution is being absorbed. Steaming is decidedly more expensive than the application of pressure, and whenever possible the latter should be substituted for it.

To permit of a fair comparison of the absorptive qualities of hemlock and tamarack, each contrasted run was chosen from material cut at the same time and seasoned in a similar manner. Both had reached as low a moisture content as was practicable, and both were subjected to the same steaming period. In every case tamarack absorbed the greater amount of the preservative, and at least after ordinary seasoning periods, is the more easily impregnated of the two species. This may be partially accounted for by the fact that due to their smaller size, tamarack ties as a rule have a greater proportion of sapwood. At any rate there is too little difference between the two species to necessitate separate methods of treatment although they should not be included in the same run except where their separation would involve extra labor and expense.

Retorts of the Escanaba Treating Plant.

Seasoning After Treatment.

The principal objection to the use of a soluble salt such as zinc chloride in wood preservation lies in the tendency to leach out on subsequent exposure to moisture. When the wood is first treated, the cell cavities are filled with the water solution, which, if brought in contact with water in the soil, permits the salt to leach out with great rapidity. If, however, the treated wood is allowed to dry out, the salt is deposited on the cell walls and no leaching can take place as long as it remains in that condition. It is therefore recommended that whenever possible the treated ties should be seasoned before they are placed in the track.

The length of time required for the seasoning of treated ties must depend primarily upon the season of the year. Ties treated at Escanaba in the latter part of July, 1905, and piled in the yard lost 82 per cent of the water absorbed during the treatment in forty-two days, and in seventy days this percentage had increased to 95. If shipped in open cars spring and summer treated ties will partially season in transit; but even at this season of the year they should be piled along the right-of-way for at least a month before being placed in the track. Ties shipped immediately after treatment in the late fall and winter lose little moisture en route, and a correspondingly longer period of seasoning should be permitted after they have arrived at their destination.

The common custom of distributing the treated ties on the ground along the right-of-way should be discouraged. In only a comparatively few cases do the treated ties become seasoned before they are unloaded along the track. There they are brought in direct contact with the moisture in the ground and seasoning is retarded. The form of pile best adapted for piling along the right-of-way is the triangular form.

The advantages of this form of pile for treated ties along the right-of-way are:

1. That the maximum rate of seasoning is secured.
2. That no tie is brought in contact with the ground at more than one point.
3. That only a comparatively few ties are required, thus permitting numerous piles along the right-of-way, with a consequent saving in the labor of carrying the ties from the pile to the track.

Conclusion.

It is improbable that a treatment will ever be secured for close-grained hemlock and tamarack which is comparable to that of the more porous species. In treating the less resistant wood with the antiseptic oil the principal objects are to secure a uniform penetration with as small amount as possible of the expensive preservative. But in the impregnation of hemlock and tamarack, especially with a salt solution, the chief problem is to inject the greatest possible amount of the preservative into the timber, and secondarily to diffuse it throughout the interior of the wood.

It should be borne in mind, however, that no matter how difficult the absorption of hemlock and tamarack may appear in comparison with that of the porous species, the treatment of these timbers is by no means unsatisfactory and results in a decided economy to both railroads and the forest resources of the country.

The following recommendations are based upon the results of the experiment:

1. The ties should be transported to the treating plant as early in the spring as possible and piled 7 by 2 to season.
2. No hemlock ties should be treated which weigh more than 40 pounds per cubic foot.
3. No tamarack ties should be treated which weigh more than 42 pounds per cubic foot.
4. Hemlock ties received at the yard before April and piled 7 by 2 will be in a condition to treat by the end of the following summer. If received much later, they should be held over to the summer of the following year.
5. Tamarack ties received in the spring and piled 7 by 2 will be in a condition to treat after three or four months.
6. Though there need be no discrimination against rafted ties, soaking to assist in the subsequent seasoning and treating is not advisable.

7. The ties should not be peeled before seasoning, with the possible exception of those intended for treatment during the winter when peeling is impracticable.

8. There should be sufficient room in the seasoning yard to hold a continuous supply of seasoned ties.

9. It is preferable that hemlock and tamarack ties be treated in separate cylinder loads.

10. For the treatment of air-seasoned hemlock and tamarack two hours' steam should be applied at 20 pounds pressure. During the impregnation with the preservative the pressure should be continued as long as is warranted by the rate of absorption.

11. After treatment the ties should be allowed to season before being laid in the track.

B. & O. Passenger Station at Harrisonburg, Va.

12. Record should be kept of the length of service given by the treated ties.

HARRISONBURG STATION, B. & O. R. R.

The handsome new passenger station of the Baltimore & Ohio Railroad at Harrisonburg, Va., is one of the most attractive in the Shenandoah Valley, thoroughly modern throughout, and in its construction the railway has spared no expense to make an imposing addition to Harrisonburg. Harrisonburg is an important point on the Shenandoah division of the Baltimore & Ohio, and the new station is part of the general improvement which the management of the railroad has inaugurated on this section of the system.

The new station is of brick construction, and has a red tile roof. It is 104 feet long by 28 feet at its widest part. Special stress was laid on the convenience of the patrons in providing for the interior arrangement of the building. The arrangement includes a general waiting-room for white persons, women's retiring room and toilet, smoking room and men's toilet, general waiting-room and toilets for colored men and women, and a spacious baggage room. Steam heat is installed throughout. A platform of vitrified brick, 325 feet in length, has been laid, 210 feet of which is protected by a butterfly canopy umbrella shed.

The location of the new station is just west of German street, between West Market and West Water streets. Upon the announcement of the location, the city of Harrisonburg opened a street leading from German street to the station. This provides a continuous driveway from German street to the building and out to West Market street. A commodious approach to the station is thus afforded, enhancing the civic attractiveness.

EXPERIMENTS WITH RED BEECH TIES.

Since 1896 experiments with red beech for railway ties have been made in the neighborhood of Eberswalde by the Prussian ministry of agricutlure and forestry, in connection with the ministry of public works. The carrying out of these experiments was entrusted to the main station of the experimental section of the forestry department in connection with the railway authorities of the Stettin line; and later with the central railway office in Berlin.

As regards the results of these experiments, and the lessons to be learned therefrom, Professor Dr. Schwappach has published a report, a concise résumé of which is here given.

(1) Sound soft-hearted beech wood, impregnated with tar oil containing creosote, is a very desirable material for railway ties; and on main lines should last at least 25 years.

(2) Sound red-hearted beech wood may be used for ties without any apprehension, if the area of the red heart does not amount to more than 25 per cent for the entire cross-section of the tie, and the heart of the log does not come near the outside of the tie. Ties with gray-dyed heart are to be rejected.

(3) In selecting the wood care is to be taken that only sound wood is chosen for ties; rotten places, and especially at large branches, are to be avoided.

(4) Especial attention must be given to thorough drying of the wood before impregnation.

(5) In order to prevent splitting of the wood, the proper precautions must be taken at once after felling the tree. Letting the felled logs lie long in the sun in the early spring, which is often very dry, is especially to be avoided.

Securing a Water Supply

Within the last few years, says the Santa Fe Employes' Magazine, the Santa Fe has constructed in southeastern Kansas a number of big reservoirs, thus remedying what was a very serious situation.

Prior to the building of these reservoirs a great deal of trouble was experienced with the water used in locomotives, and a heavy expense was incurred in hauling water by the trainload for use at the various stations. The construction of the reservoirs made it unnecessary to erect and maintain costly water treating plants, and now that section of the road is bountifully supplied with water considerably above the average for boiler purposes.

Work on the reservoir two miles east of Welda was commenced on December 10, 1906, the undertaking being completed six months later. An earthen dam 830 feet in length was constructed, with a 16-foot crown and a 32-foot base, the inner face of the bank being covered with riprap. Two concrete spillways, each 115 feet in length, were constructed together with a concrete intake.

The source of water supply at Welda is the Bradshaw Creek, the reservoir having a capacity of 126,100,000 gallons. The site comprises 132.4 acres, with over fifty acres flooded at high water, to an average depth of 5.8 feet. The water is pumped through a six-inch pipe to Welda, a total lift of 63 feet, and at Welda passes into a steel tank, 24 by 43 feet. Ransom & Cook were the contractors for the grading, riprap and pipe line work, the Santa Fe doing the balance of the work.

This reservoir cost $36,204. It has splendid grassy banks, and on it good fishing and boating is indulged in. The Country Club Association, composed of railway men and including in its ranks mostly Santa Fe men, has set out trees along the banks and is building a clubhouse and otherwise improving the grounds.

A few stations north of Welda is what is known as the Richmond reservoir, situated one mile west of Scipio station. The water is pumped over two miles through a six-inch pipe line to Richmond, the water being secured from 2.44 square miles of surface drainage. The capacity of the reservoir—which covers 105.5 acres, sixty acres being flooded at high water to an average depth of 6.3 feet—has a capacity of 132,000,000 gallons.

Work on the Richmond reservoir was commenced on November 27, 1907, but, owing to a portion of the dam being washed away in June, 1908, it was not completed until January 1, 1909. It cost $41,320. The earthen dam, 992 feet long, is 16 feet wide at the top and twice as wide at the base. The inner face is covered with riprap. There are two concrete spillways, each 104 feet long.

Owing to the porous nature of the ground on which the reservoir was built, and the numerous deep sinks in it, fifty carloads of fine Arkansas River sand was spread over the flooded surface, and a trench was sunk to bed rock and filled with concrete in the center of the embankment, thus practically preventing any seepage whatever.

Two miles south of the depot at Chanute a reservoir with a capacity of 160,000,000 gallons and costing $70,000 was completed on February 1, 1911, the work having been started on July 11, 1910. In building it was necessary to condemn a brickyard site and a portion of a refining plant and to move a section of track. This reservoir furnishes water for the roundhouse, shops and yards of Chanute, which is a division terminal.

Richmond Reservoir Before Being Flooded, A. T. & S. F.

The supply of water is received from 3.75 square miles of drainage surface, mostly meadow land. There is an embankment of earth, 4,000 feet long, with a 16-foot crown and a 32-foot base, the inner face being ripprapped. A concrete spillway, 280 feet in length, has been built in the solid rock. The site covers 151.4 acres, with the right to flood adjacent property. At high water eighty acres are flooded to an average depth of six feet. Ransom & Cook did the earthwork and ripprapping.

A fine reservoir, with a concrete dam, also has been built at Edgerton, on the Emporia cutoff, which has solved the question there of giving a permanent water supply.

All the work on these various reservoirs was done under the direction of J. M. Meade, engineer of the Eastern Lines, with N. M. Wells, division engineer, directly in charge of the three first described.

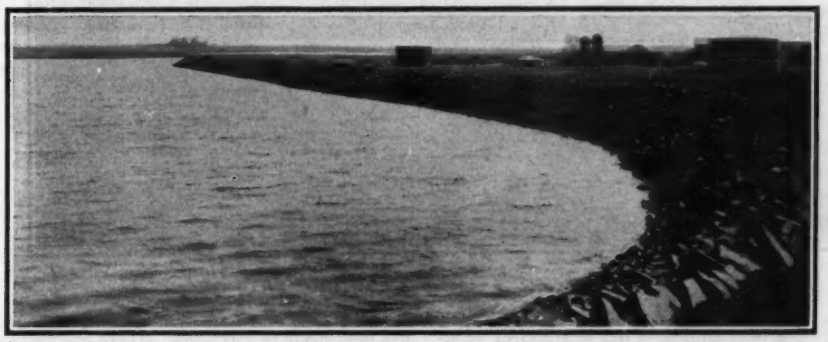
RECLAMATION OF TIDE LANDS.

Continued from page 381.

Influence of Draining Tide Marshes on Public Health.

Along some parts of the coast of Long Island and New Jersey efforts have been made to drain the marsh lands as a means of ridding neighborhoods of mosquitoes, and have been partially successful; but without a general effort and the drainage of all the marshes in a certain locality the best results can not be secured. A most successful example of the effect of drainage on health conditions is to be seen in the drainage of the neck at Charleston, S. C. The city of Charleston is located on a tongue of land between the Ashley and Cooper rivers. This land was formerly infested with mosquitoes and was extremely malarious. This land has been thoroughly drained. The report of the sanitary and drainage commission of Charleston County, S. C., for 1905, speaking of the results, says:

"When we took charge of this territory, ponds and morasses were everywhere. The Anapholes mosquito, the disseminator of malarial poison, was present by the millions. The public road was almost impassable in places, and the public ditches choked up and more or less filled with a stagnant water, and the whole country had the appearance of the utmost neglect, and there were but very few business enterprises with the exception of the fertilizer factories. Today there are no ponds, no morasses, the Anapholes has been banished, and an avenue 40 feet wide, with ditches on each side, has been built to Tennile Hill. A new town has been laid out and 100 homes are being erected in this town. New dwellings and new stores are to be seen on all sides."



Chanute Reservoir, A. T. & S. F.

Best Methods of Reclamation.

There are three things in the reclamation of salt marsh that require special attention and treatment. These are:

(1) The method of protecting the land from overflow by tide waters.

(2) The plan of internal drainage.

(3) The treatment of the soil to rid it of the excess of salt.

The usual, and probably the best means, of protecting a marsh from the overflow of the tide is an earthen embankment constructed of the material found along the line of the work. The location, size, and character of this embankment are of the utmost importance, as upon its efficiency and stability depend the success of the reclamation. Practically all the failures in reclaiming marshes in both this country and Europe have been due to the lack of proper precautions in the construction of embankments.

Location of Dikes.

In locating a dike there are many things to be considered:

(1) The direction must be such that with the shortest line of dike the greatest possible area may be inclosed. An examination of this principle shows that the larger the area to be inclosed the less it will cost per acre to do the work.

Marsh lands are frequently so situated that they do not require embankments on all sides; yet this general rule holds good—the larger the area the less the cost per acre to inclose it. This shows the importance of cooperation in this work. Where the marsh is held in small tracts, as is the case in many of the New England and Middle Atlantic States, it can be embanked at a much less cost per acre if the owners organize into districts as they do in some parts of Nova Scotia and New Brunswick. There they have dike laws for reclaiming and protecting tide marshes. The principle of these laws is very much like those of the drainage laws in some of our States, and under their operation much work has been done that could not have been accomplished by individual effort. Under the dike laws whole townships of the best agricultural lands have been created from worthless bogs and morasses.

(2) The dikes should run parallel with the coast or stream, or else at right angles to it, and should have a wide berm or foreshore between the toe of the slope and the water's edge. The action of the waves is less destructive when they strike the bank at right angles than when they strike it obliquely, and they also do less damage where there is a wide berm in front of the dike. Experience shows that dikes which lie directly on the brink of the shore are much more liable to injury than those which lie farther in and have some land before them. In no case should the width of the berm be less than that of the base of the dike, and when the embankment is exposed to the action of the wind or waves it should be 100 feet or more in width. The distance from the shore must be determined in a great measure by the quality of the ground. It should be located far enough away from the stream or shore to be secure against undermining by caving.

Height of Embankment.

After locating the dike the height is the next important element to be considered. No one can tell with certainty to what point a storm tide at any point will rise, but when observations extend over a long term of years the greatest height reached may be safely taken as the maximum that is likely to occur in the future. The height of the embankment should be at least 18 inches above this mark. This may seem excessive, but nothing less is absolutely safe. When the waves reach near to the top of the embankment and a strong wind prevails, much damage is likely to occur, and in case they overtop the embankment the entire work may be greatly impaired or even destroyed.

Causes of Failure.

From a personal inspection in a number of places and the testimony of trustworthy people along the coast where the reclamation of salt marsh has been carried on, the following are noted as the chief causes of failure:

(1) The inefficiency of the dikes because of poor construction from a lack of knowledge as to how to do the work or a false economy practiced in the construction of the same.

(2) The failure of the tide gates to keep out salt water and their lack of capacity to vent the accumulation of fresh water at low tide.

(3) The lack of proper care of the dikes after they are constructed.

In nearly 100 cases of failure investigated the reason assigned was that the "dike went out." Upon a further examination in most cases it was easy to see why the dike went out. It was located too near the shore and was cut away by the action of the water; was too low and was overtopped by the waves; did not have sufficient cross section to withstand the pressure; was built on a poorly prepared base, or was destroyed by muskrats. While the embankment stood, the reclamation was a success and disaster only followed its giving way. It has been thoroughly demonstrated in many places that an earth embankment will stand if properly constructed, and there is little excuse for failure. Nowhere is the old maxim "whatever is worth doing is worth doing well" more forcibly illustrated than in the building of a dike. Many persons have undertaken this work without knowledge as to how it should be done and have persisted in carrying on a practice that was radically wrong, while others have had but little confidence in the ultimate success of their undertaking and have not been willing to put in sufficient funds to properly do the work. It has been their aim, if after a time the work proved profitable, to enlarge and strengthen the embankment, but this method can not be successfully carried out, because the earth while it is yet fresh, to withstand the action of the water, must be put up in the proper manner and of sufficient quantity. If the embankment is too low and is once overtopped by the waves it will practically be destroyed. If the cross section is too small or has steep slopes it will not withstand the action of the waves and will give way when most needed.

Another reason for insufficient embankments having been constructed is the lack of proper appliances for doing the work. It is only within recent years that dredges have been constructed suitable for this work and where it was put up by hand labor it was difficult, because of the water, to secure the necessary material near the work, and the cost of handling earth in that way made large and substantial embankments prohibitive in many places, but with the introduction of modern machinery this difficulty is removed and large embankments can now be built at a less price per cubic yard than smaller ones.

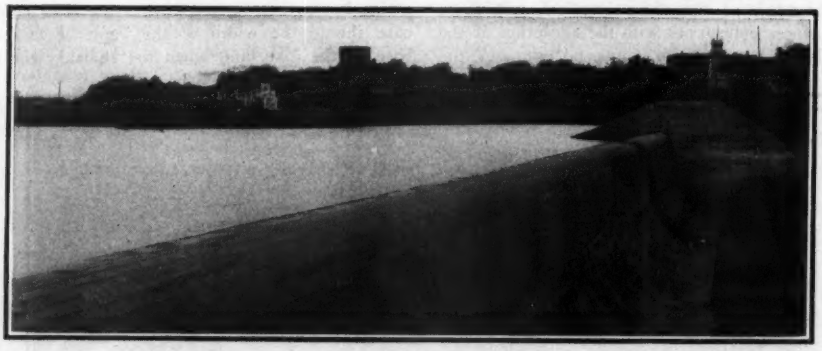
Another source of trouble has been the sluices. These have rarely ever been large enough to serve their purpose, and have been put in in such a way that many of them have failed at a critical time, flooding the meadows and thus destroying the work of many years. With the cheapness of concrete construction, permanent structures can now be made at a reasonable cost, and such structures of unquestioned capacity should be constructed in all embankments made. If care is taken to secure a proper foundation such tide gates will be permanent and efficient.

In many places complaints are made of the ravages of muskrats. It is stated that they burrow in the embankment and cause it to give way during periods of high tide. This trouble can be greatly lessened, if not entirely avoided, by keeping the embankment free from a rank growth of vegetation. It should be mowed at least twice a year and the material cut at once removed. This will destroy the harbor for these animals, and the damage they do can be more readily detected and repaired.

Where an embankment is constructed by a number of landowners there seems to be a division of responsibility, and no one looks after it and it does not receive the care necessary for its protection and security.

If instructions given in this report are closely followed as to the location, construction and care of the embankments there should be fewer failures in the future.

It has been fully demonstrated by the work done in Nova Scotia and along the Atlantic coast that many of our marine marshes can be reclaimed and made profitable for agriculture. Such being the fact, it is natural to inquire why so little progress has been made in this work. There are many reasons why more work of this kind has not been done, among which are:



Reservoir at Edgerton, A. T. & S. F.

(1) To do such work economically it must be carried on upon a large scale. This requires a considerable outlay of money or labor, or both, and the individual ownership of large areas of marsh land or cooperation among several small owners. This outlay must all be made and two or more years elapse before the marsh will yield any returns. American farmers and capitalists prefer, as a rule, to work for results that come more quickly or to invest in securities that are convertible into cash on short notice. This lack of means has held back many persons who are fully aware of the fertility of the land and convinced of the great profit that would result from its reclamation, but the lack of sufficient funds, together with the knowledge of certain failures that have been made, has perhaps more than any other consideration held back the reclamation of large areas of recognized fertile lands.

(2) In the New England and North Atlantic States nearly all the marsh is owned in small tracts in connection with the highlands, and it is extremely difficult to get the proprietors interested to unite in carrying out any comprehensive plan of improvement. No one holds enough land or has sufficient interest to take the time and spend the money necessary to work up an organization for joint effort. This want of united action among the many owners of small tracts has been a great drawback to the improvement of the marshes along our coast.

(3) Another serious hindrance has been the lack of proper tools with which to do the work. Because of the swampy conditions where the work is to be done and the amount of water encountered, it is both difficult and expensive to construct a large

embankment by hand labor. In many localities where the marsh is favorably located and could be reclaimed by a small amount of labor, the lack of information as to how banks should be built and experience in doing the work have held back many owners from reclaiming small tracts of very valuable land. Education along this line of work, the improvement and development of machinery suitable for carrying it on, and the accumulation of capital available for projects of this kind will no doubt remove many of these hindrances and bring about improvement in this work.

In order to encourage the development of these marine marshes, the Federal Government should be induced to cause a survey to be made to determine their area, character, and fitness for reclamation and the probable cost of doing the work. Such an examination would have a tendency to establish their commercial value and would be of inestimable benefit to both the owners and the Government.

Simple but equitable drainage laws should be enacted by each state having within its borders any considerable amount of salt marsh. Without such a law the progress of reclamation would be slow. It is not right that a few men, owning but a small portion of the marsh, should prevent its improvement and development by refusing to sell or aid in the cost of the work and yet reap the benefits when made by others. Such will, however, always be the case in the absence of just and equitable drainage laws. The drainage of the farms in Ohio, Indiana, Illinois, and Iowa would never have reached such a degree of perfection as they have, had it not been for the efficient drainage laws enacted by the several states. In both Nova Scotia and New Brunswick, where diking is so extensively employed, they have complete statutes providing for their construction and maintenance, and no material progress need be expected in this country until we have such laws enacted.

Since our eastern coast has become so thickly populated, any state has, under its police regulations, the power to declare this mosquito-breeding marsh a nuisance and a menace to the public health and compel their abatement, thereby bestowing upon the owners a blessing that they have so long and so persistently refused to accept.

Any state law that would provide for the formation of a district comprising a marsh or series of marshes that could be reclaimed under one plan of improvement and trust the management of its affairs to a board of interested landowners, would be a step in the right direction. Such a law should clearly define the riparian rights of the owners and show the status of such improvement in its relation to the navigation of streams on which such lands are located. It should also make provision for doing the reclamation work as a whole and provide for the issuance of bonds, to be a lien on the lands benefited, to raise money for paying for the work as it is done. These bonds should run for a long term of years at a low rate of interest and be paid in annual installments by a tax on the land reclaimed in the ratio that such lands are benefited by the improvement. Such a law would not work a hardship on the landowners and would enable anyone having unimproved marsh to reclaim the same and pay the cost out of crops to be produced after the work is completed. To further encourage this work the several states should remit the state and county tax on lands thus reclaimed until the cost of improvement has been paid, as the benefit to the state from the increased population and products raised on the marshes will be of more value than the land itself in its present condition.

Design of Eccentrically Loaded Concrete Members Reinforced on One Face Only

By Charles H. Dutton, Member Boston Society of Civil Engineers.

The following paper is intended to assist in the design of reinforced concrete structures which are stressed mainly in compression, but on account of the eccentricity of the resultant line of pressure, require reinforcement on one side of the section only. There are many cases of this kind, such as retaining walls, subway arches, etc. The text-books in common use give methods of designing symmetrically reinforced members under combined direct compression and flexure, but do not cover the case of reinforcement on one side only, and, while the exact solution of the case under consideration may be effected by means of a cubic equation, the process is very laborious compared to the use of a simple table and diagram.

Let

f_s = fiber stress in the steel.
f_c = maximum stress in the concrete.
E_s = modulus of elasticity of the steel.
E_c = modulus of elasticity of the concrete.
$n = \frac{E_s}{E_c} = 15.$
d = distance from center of steel to compressive face of the concrete.
b = breadth of the member.
kd = distance from the compressive face of concrete to the neutral axis.
N = the axial stress.
e = distance from a point midway between the steel and the compressive face to line of the axial stress.
p = the ratio of area of steel to that of concrete.

*Presented before the Association of Engineering Societies.

By the straight line theory—

$$f_s = nf_c \frac{1-k}{k}. \tag{1}$$

Σ parallel forces:

$$N + f_s bdp = \frac{kd}{2} f_c b. \tag{2}$$

Moments about the centroid of compression:

$$N\left(e - \frac{d}{2} + \frac{kd}{3}\right) = f_s bdp\left(d - \frac{kd}{3}\right). \tag{3}$$

Solving equations (1), (2) and (3) simultaneously, since the member is in equilibrium—

$$p = \frac{k}{4n(1-k)}\left[\frac{N}{ef_c b} + 2k - \sqrt{\frac{N}{ef_c b}\left[\frac{N}{ef_c b} + 8k\left(1 - \frac{k}{3}\right)\right]}\right]. \tag{4}$$

$$d = \frac{4e}{-1 + \sqrt{1 + \frac{8k\left(1-\frac{k}{3}\right)}{\left(\frac{N}{ef_c b}\right)}}}. \tag{5}$$

Since equation (4) is solved from a quadratic, it requires a plus sign before the radical. It is omitted, as it gives negative vale of d. Equations (4) and (5) are for the numerical solution of the problem, the value of k being obtained from equation (1) by assuming values of f_c and f_s.

As the numerical solution is somewhat laborious, the following solution by means of a diagram will be found convenient.

Transposing equations (4) and (5) respectively:

$$\frac{N}{ef_c b} = \frac{p\left[12n^2(1-k)^2 p - 12n(1-k)k^2\right] + 2k^3}{6n(1-k)kp + k^2(3-2k)}. \tag{4a}$$

$$k\left(1-\frac{k}{3}\right) = \left(\frac{N}{ef_c b}\right)\left[\frac{e}{d}\left(\frac{2e}{d}+1\right)\right]. \tag{5a}$$

On the diagram $\frac{N}{efcb}$ is the independent variable or abscissa; k or $k \quad 1-\frac{k}{3}$ is the dependent variable or ordinate, and p and $\frac{e}{d}$ are constants. When computing the diagram from equation (5*a*) use $k \quad 1-\frac{k}{3}$ as the independent variable. If the values of $k \quad 1-\frac{k}{3}$ are plotted instead of the values of k, equation (5*a*) reduces to an equation of the first degree in k, and therefore plots as straight lines. Thus a single point on the diagram represents four quantities, viz., $\frac{N}{efcb}$, k, p and $\frac{e}{d}$. The table represents k f_c and f_s.

If f_c and f_s are taken as constants, k becomes a constant, thereby much simplifying the problem.

The diagram may be equally well applied in determining the stresses in a structure of known proportions, or in designing a structure to resist definite external forces without exceeding certain limiting stresses. In the former case, p and $\frac{e}{d}$ are known, and by locating the intersection of the straight diagonal line corresponding to $\frac{e}{d}$ with the proper curve for p, we read at once the value of $\frac{N}{efcb}$ of which f_c is the only unknown quantity. Having obtained this, f_s may be obtained by taking k from the diagram and using k and f_s in the table.

In the other case, namely, to design a structure with definite limiting stresses, we may calculate the value of $\frac{N}{efcb}$ and may obtain k from the table to suit the value of f_c and f_s. With $\frac{N}{efcb}$ and k, the diagram will show the value of $\frac{e}{d}$, from which the necessary d may be obtained, and p, from which, knowing b and d, the area of steel may be determined.

It is of course assumed in any case that the external forces are known. These are represented by the resultant thrust N and the eccentricity of the thrust e. That is to say, the moment may be made equal to Ne, and e determined by this means. In case the stresses are determined graphically, both the N and the e may be taken directly from the equilibrium polygon.

It is also possible to assume $\frac{N}{efcb}$ and d, and compute p and f; or vice versa. In the above work the eccentricity has been denoted by e, the distance from a point midway between the steel and the compressive face, to the line of force, N, which is perhaps the most useful method in connection with the design of arches, as the value of e changes but slightly with varying values of d.

It will of course be recognized that the above analysis is only one of several possible methods of reaching the desired solution and it may often be more convenient, when designing new work, to use some other. The question as to which is more desirable depends upon the allowable method of varying the strength. If the thickness of the wall is determined in advance, d is practically determined and consequently e, by settling the amount of cover for the reinforcement and thus

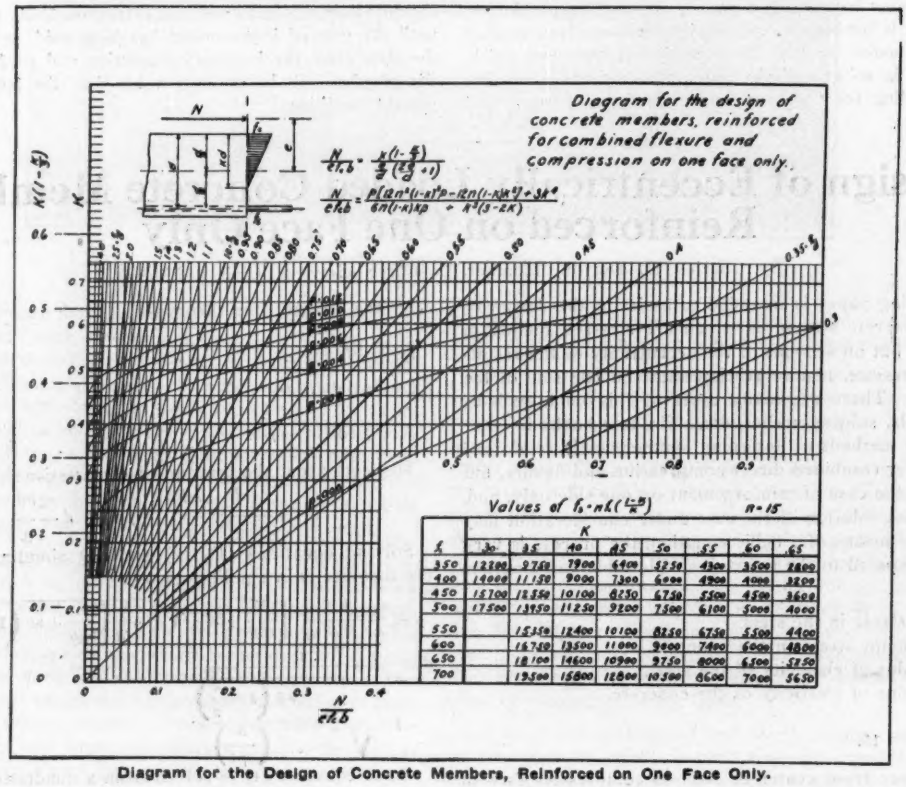


Diagram for the Design of Concrete Members, Reinforced on One Face Only.

locating the center between the reinforcement and the compression face.

It may be, however, that we wish to leave the thickness to be determined later, and the distance from the resultant line of pressure to the face of the wall, rather than to the center, is the condition fixed by circumstances. A familiar instance of this is in the case of a wall, such as the spandrel wall of an arch carrying an overhanging sidewalk. Here a different diagram might be more convenient.

Under other circumstances, it might be that the distance from the resultant pressure to the center of the reinforcement is determined in advance and that the location of the compression face is immaterial. Under these circumstances the value $e + \frac{d}{2}$ is the constant, and the formulas might be modified by substituting a value, as $i - \frac{d}{2}$, for e. This results in simplifying the equations to some etxent, as several terms are canceled. It will be found, however, that a similar diagram will be the most convenient way of using these equations.

Generally speaking, however, it is possible to use the accompanying diagram, as the thickness of the wall can generally be assumed with sufficient accuracy, or obtained by one trial assumption.

New Locomotive Terminal, Chicago & Alton, at Bloomington, Ill.

The locomotive terminal facilities of the Chicago & Alton Railroad at Bloomington having become inadequate to handle the large number of locomotives required by the great increase of business during recent years, and more so as the size of the locomotives has increased proportionately with the business, the company authorized last year a considerable enlargement of this terminal plant, and commissioned Westinghouse, Church, Kerr & Co. to design and build a new round house with a turntable, coaling station, water tanks and cranes, sand storage and drying house, and cinder pits. These new facilities are located upon land acquired for the purpose, immediately adjoining the former locomotive terminal on the west side of the present railway shop and terminal property. The soil was of good character for the most part, well suited for carrying the structures, so that the foundation work presented no difficulties.

Ashpits and General View of Roundhouse, Bloomington, Ill., C. & A. R. R.

Round House.

It is of interest to note that the new round house is the third one constructed at this terminal, each one having been considerably larger than its predecessor.

The round house has 44 stalls (one of which is occupied by the boiler washing system), with a 100-ft. turntable. The circle of the building, which would be filled out by a total of 50 stalls, is thus almost completed. Its inside depth is 100 ft., with an annular space about 65½ ft. wide between the round house door posts and the turntable pit. The building is of brick, with flat wooden roof supported on timber posts, and is divided into four sections by 13-in. fire walls. The floor throughout is of concrete. The rear walls between the main supporting pilasters are about 8½ ins. thick and rise to 4 ft. 3 ins. above the floor level; above this, all the remaining space in each bay between pilasters is given entirely to windows so that the interior is well lighted; and as the space between the pilasters is bridged by timber girders supporting the roof, very little else besides windows can be injured in case a locomotive accidentally goes through the round house wall. The foundations throughout are plain concrete footing.

The door posts are on 14½ ft. centers, the doors being of the double swinging wooden type, about 17½ ft. high, with 5 ft. transoms above.

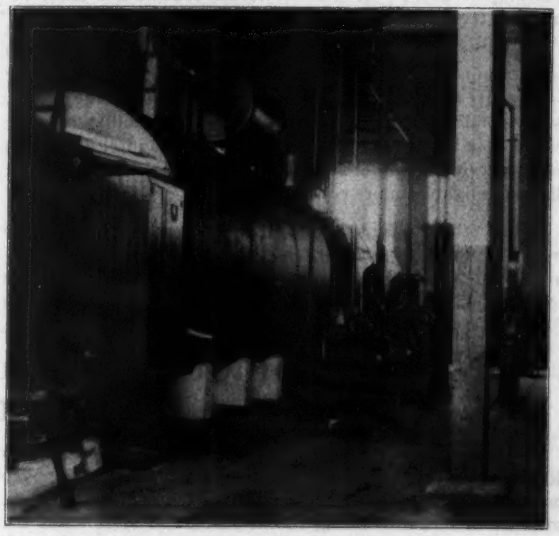
The engine pits are 77 ft. long, the bottoms sloping from 2½ ft. depth at one end to 3-ft. at the other. Twelve pits, in two sections, are intersected by driver drop pits; and five adjoining engine pits in one section are intersected by a

truck drop pit. All pits are of concrete construction, all side walls being 2 ft. 4 ins. thick to provide a jacking ledge. The forward end of each engine pit is arranged with a depression outside of each track rail, 16 ins. wide and 11 ins. deep below the rail head, to permit the ready insertion of jacks under bumper beams of low-wheeled engines. The engine pits are fitted with hinged track rails where intersected by the truck and driver drop pits, and the latter are bridged with movable I-beams to support the hinged rails when swung around. The drop pits when not in use are covered over with steel trap doors.

The building is heated by the indirect system, using hot air, which is supplied by two 180-in. engine-driven fans capable of completely renewing the air in the building every 18 mins. The two fans with their heating stacks are mounted in separate fan houses, about 24 ft. square, built as small additions to the round house. The hot air is conducted from each fan by two main ducts formed of concrete below the floor, running each way from the fan house along the rear wall of the round house. Branch ducts of round tile distribute the hot air from the main ducts to the engine pits; short branch ducts of sheet metal spaced two under each window, also conduct hot air from the main duct to register openings in the rear wall 3 ft. 6 ins. above the floor. The largest of the main ducts is 47 ins. wide by 60 ins. deep at the fan, and delivers hot air to fifteen stalls, tapering to 22 ins. wide and 24 ins. deep at the last stall. Heat is supplied to the fan pumps by live steam (no exhaust steam being available), from the power house, through a 6-in. main which also furnishes steam for the fan engines and the boiler washing pumps and to the steam blower connection at each stall for blowing up locomotive fires.

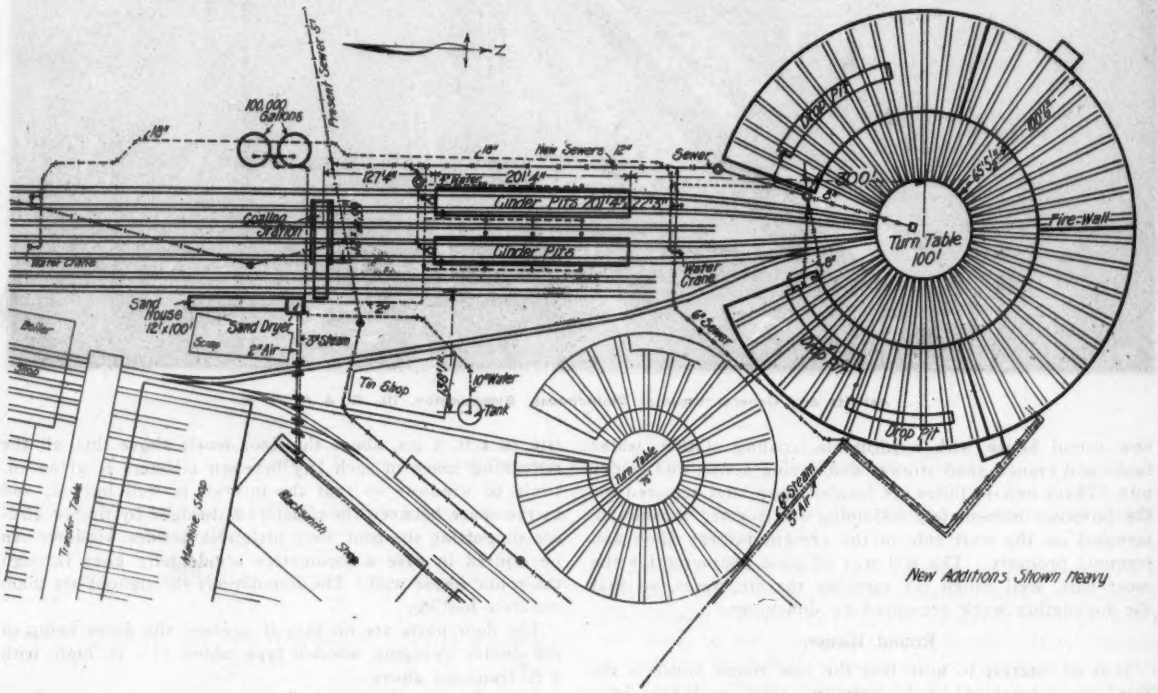
Boiler Washing System.

For saving heat and shortening the time that would otherwise be lost in locomotive boiler washing and placing washed boilers under steam again, a boiler washing system is provided which is that covered by the patents of the National



View of National Boiler Washing Plant in Roundhouse.

Boiler Washing Co., Railway Exchange Bldg., Chicago. Briefly, the operation consists in blowing off the locomotive boiler into a wash-out tank through a filter, the steam in the blow-off water being liberated by the reduction in pressure and used to heat the fresh make-up water while the latter is on its way into the filling tank, whence it is pumped as required into boilers already cleaned, at a temperature of about 180 degs. The filtered blow-off water is pumped from the wash-out tank as required for boiler washing, being mixed with as much fresh cold water as is needed to make the temperature convenient for handling.



General Layout of New Terminal, C. & A. R. R., Bloomington, Ill.

The apparatus consists of a closed horizontal cylindrical tank 10 ft. in diameter by 20 ft. long for the filling water with a 14 in. x 10 in. x 12-in. duplex pump; a similar tank and pump being provided for the wash-out water; also an open heater, a filter, a sludge tank, and the necesary piping and valves. This apparatus fills the space ordinarily occupied by one stall in the round house, and has capacity for blowing off three, washing three, and filling three locomotives at one time. Separate pipe connections for blownig off, washing and filling are provided at each stall; also a cold water pipe connection for general service, floor washing and the like, and a compressed air service pipe, are provided at alternate stalls. There is also a separate fire line connected to the city water system, with sixteen 2-in. plugs distributed throughout the round house for fire protection.

All service piping except the boiler blow-off pipes, which run overhead to the water storage tank, is laid in trenches in the floor, with iron cover plates. This system of trenches includes a pipe tunnel about 4 ft. wide and 5 ft. deep, which follows a circular course at the front of the round house, just within the doors, lateral ducts radiating to the engine stalls.

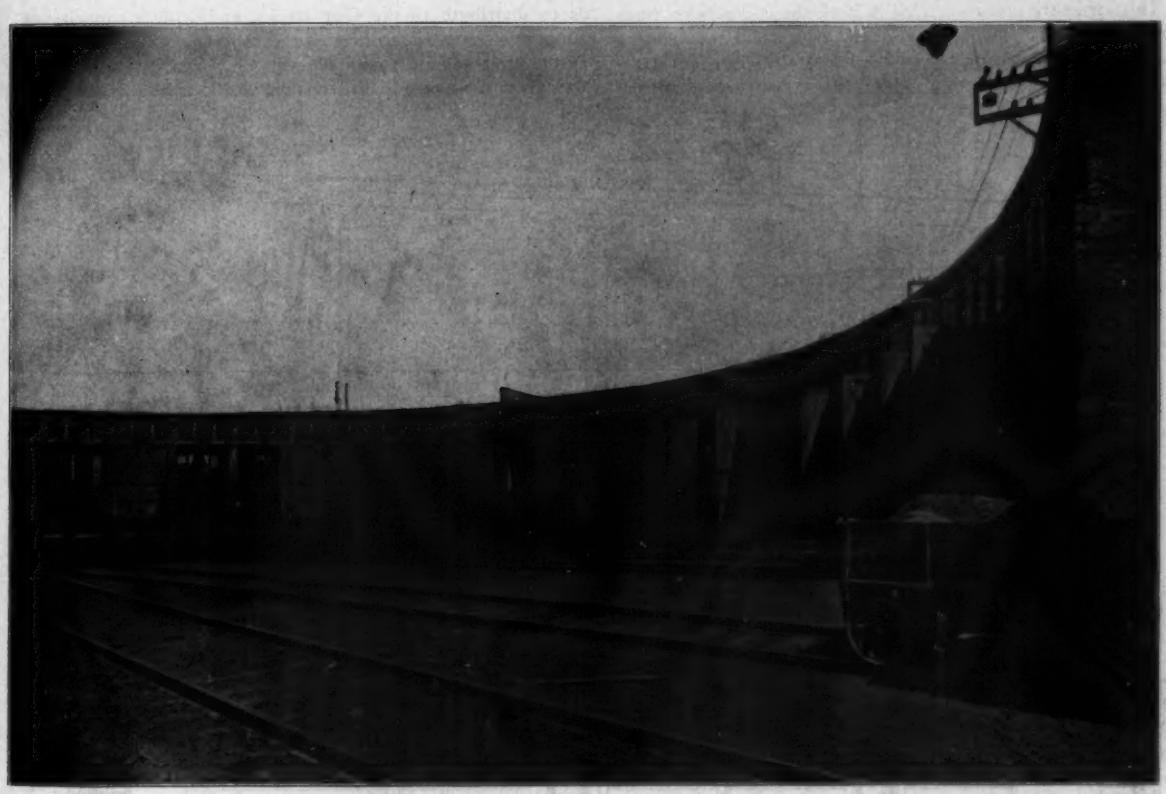
The house is ventilated by 32 in. x 24-in. cast iron roof ventilators placed over every other stall. The smoke jacks are of asbestos, molded to form, and bolted together. The hoods are 10 ft. long, so as to permit of some movement of locomotives without removing the stacks from under the jack.

Artificial illumination is provided by 250-watt tungsten lamps, two of which are suspended by short pipe fixtures from the roof directly over the spaces between stalls. The lamps are of the 110-volt type, and the two lamps in each stall are in series on the 220-volt 2-wire distribution system, and are controlled by wall switches. Each stall is also provided with a convenient arrangement of wall brackets for attaching extension lamps and portable motors for tools.

All wires for electric service are rubber covered and drawn into galvanized metal ducts of the Sherarduct type. For lighting the turntable and tracks outside the round house doors, four flaming arc lamps are provided, mounted on wall bracket fixtures at suitable intervals on the front of the round house.

Turntable.

The 100 ft. table is of the deck type and electrically operated. The turntable girders are about 7½-ft. deep at the center, the center casting being supported on a reinforced concrete footing about 6 ft. 5 ins. deep and 15 ft. square at the base, which is reinforced by 1-in. square rods. The ring wall is of plain concrete, extending 9 ft. 9½ ins. below the top of the rail, and is 8 ft. 8 ins. wide across the base, and 2½ ft. wide at the top. The circle rail is spiked on wooden blocks embedded in concrete. The pit is drained by 8-in. tile drain leading to the sewage system. The turntable was constructed by the Toledo Bridge & Crane Co. The turntable tractor was furnished by George P. Nichols & Bro., Chicago, and utilizes a 20 h. p. d. c. motor of the crane type, receiving current from wires carried by a 2-in. Sherarduct conduit laid under the bottom of the pit and coming out through the center. There is also provided an electrically driven winch for pulling dead locomotives on and off the turntable.



Roundhouse and Turntable, C. & A. R. R., Bloomington, Ill.

Coaling Station.

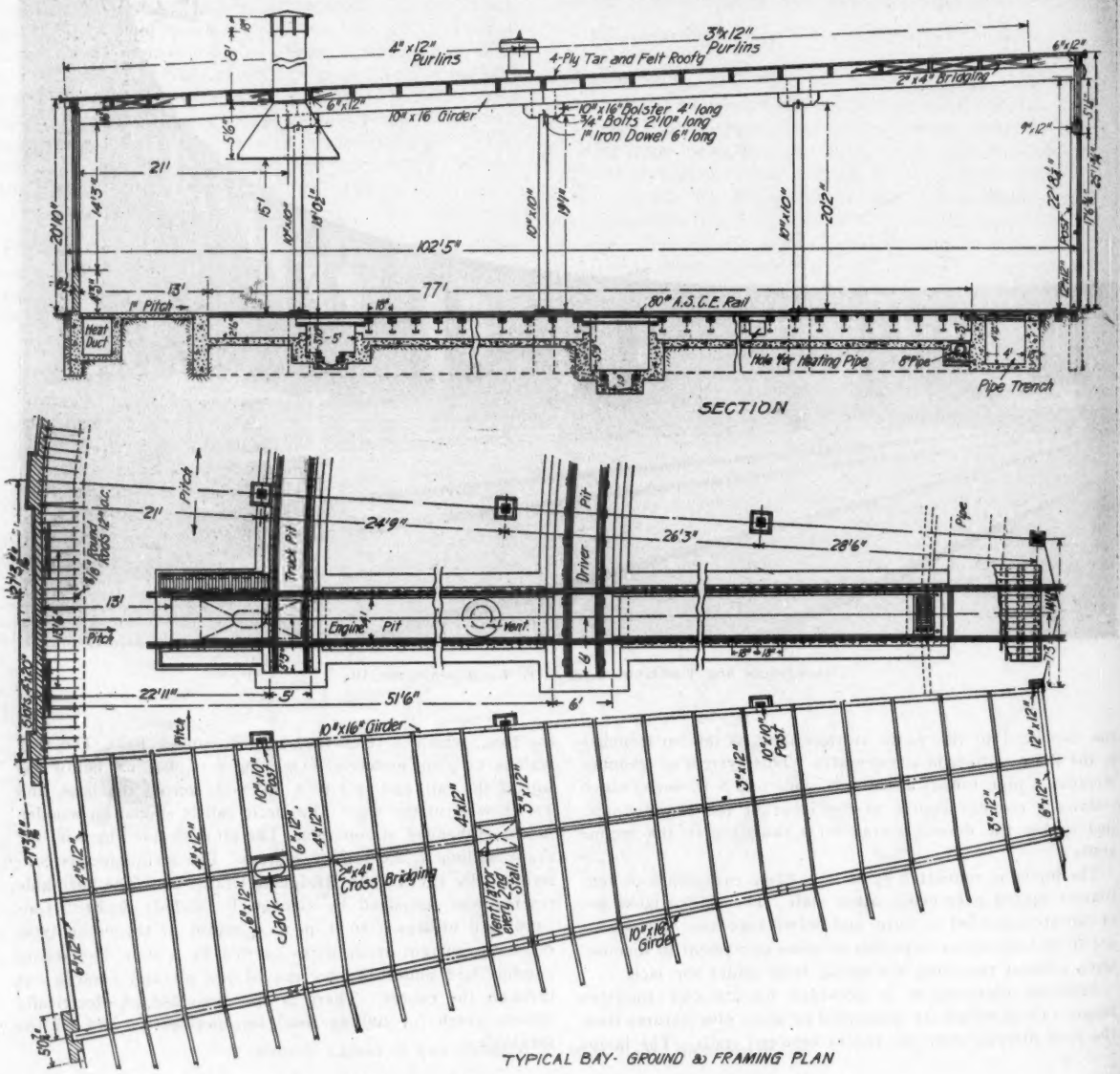
The locomotive coaling station is of the elevated bunker type, extending across the tracks and comprising a substantial structure of steel and reinforced concrete. There are two receiving tracks, underneath which is a concrete pit about 35 ft. long, 20 ft. wide and 21 ft. deep, in which are located two receiving hoppers and crushers. Each crusher can discharge into either of two independent bucket elevators, each of 80 tons capacity per hour, and with a total round trip bucket travel of 330 ft., which convey the coal from the crushers and distribute it through the bunker from which coal is conveyed to locomotive tenders by discharge spouts. One of the tracks under the coal bunker is used entirely to give ash cars access to and from the cinder pit. Locomotives can be coaled on four tracks, three passing through underneath and one beyond the end, of the bunker structure. There are six coal spouts altogether, two tracks having two each and the other two one each.

This structure being on filled-in land, the concrete footings for the columns extend down about 20 ft., and the sides of the crusher pit are of heavy reinforced concrete construction. The steel supporting columns of this structure are encased in concrete. The sides and roof of the superstructure above the coal bunker are covered with corrugated asbestos siding. The bunker is of the self-emptying type, with inclined bottom section of reinforced concrete, and has a capacity of about 525 tons. The coal crushers, conveying machinery, and delivery spouts were furnished by the Exeter Machine Works. Each conveyor has its own separate 15 h. p. motor, and each crusher is operated by a 25 h. p. motor, all of the 220-volt enclosed d. c. type. The conveyor motors are situated in the top of the bunker structure, and are controlled from the crusher pit. The crusher motors are fitted with outside ventilating pipes.

It should be noted that the coal handling machinery in this station is all in duplicate, and it will be shown below how it can be further relayed in emergencies by using the ash car loading apparatus at the cinder pits.

Sand Storage.

The dry sand supply is stored in three bins so arranged as to distribute to the four tracks, and with a capacity of about 7½ cu. yds. storage for each track. Green sand is stored in a bin of about 400 cu. yds. capacity, located on the ground alongside the coaling station, and is dried in



Bloomington Roundhouse, C. & A. R. R.

two steam dryers, screened, and elevated by air pressure into dry sand storage bins arranged in the coal bunker structure directly underneath the coal pocket, whence it is fed by spouts to the locomotive sand boxes as required.

Water Supply.

The general water service, not only for locomotive tanks, but for supplying the miscellaneous needs of the terminal, is taken from the railroad company's regular water supply system, which for the enlarged terminal has been supplemented by two new 100,000-gal. wooden storage tanks located near the center of the locomotive terminal yard, on a steel structure 20 ft. high, the tanks themselves being 30 ft. in diameter and 20 ft. in height. From these tanks water is distributed to four 12-in. water cranes, two of which are located near the round house end of the terminal yard, and the other two at a point about 667 ft. toward the other end. The tanks and cranes are connected by an 18-in. continuous main. A supply is also carried into the round house for general service purposes. The tanks and water cranes were built by the U. S. Wind Engine & Pump Co.

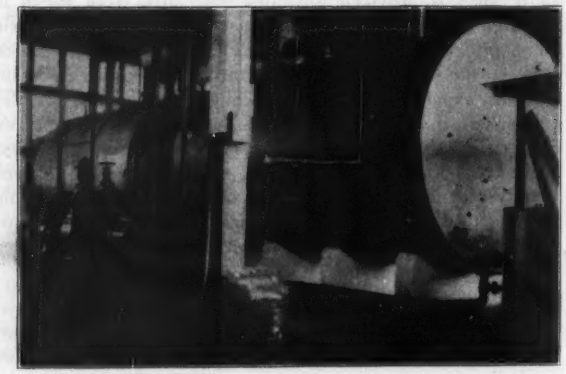
Cinder Pits.

Two cinder pits are located in the four tracks which lead to the round house. Each pit serves two tracks, which are 16 ft. between centers, the two pits being parallel and 48 ft. from center to center. Each pit is 200 ft. long and about 8½ ft. deep, with sides and bottom of concrete. The outer rail of each track rests upon the concrete retaining wall of the pit. The inner rail is supported upon 18-in. I-beam stringers encased in concrete, and carried on concrete piers 10 ft. apart. The sides of each pit are sloped towards the center, causing the cinders to accumulate in the open space between the tracks. For loading these cinders a travelling crane of 80 ft. span is provided, spanning both pits, from which is operated a grab bucket, which hoists the cinders from their dump pit and deposits them in cars upon the central track between the pits. The girders of the crane runway are 20 in. I-beams, supported on lattice columns at 20 ft. intervals, the columns resting on substantial concrete footing. The crane is electrically operated, with four motors, for travel, trolley, hoist and bucket opening respectively. The cinder pits are usually kept filled with water to a depth of 4 ft. or 5 ft. This equipment has also been successfully used for coaling locomotives directly from loaded coal cars placed on the cinder track.

Steam Supply.

The steam needed for the round house equipment is supplied from the main power house by a 6-in. line about 760 ft. long, placed underground in a conduit of 15-in. channel tile pipe, laid in 2-ft. lengths, split longitudinally. The lower half is laid first, and every 14 ft. a roller chair is placed on a concrete bed for carrying the pipe, the upper half of the tile conduit being placed after the pipe and its covering are in position. The steam pipe is covered first with a single thickness of 6-in. sectional 85 per cent. magnesia, over which is another thickness of 8-in. sectional covering. The outside diameter of this covering is enough smaller than the interior diameter of the conduit to leave a sufficient runway underneath the pipe to carry away water that may enter, and keeping it clear of the magnesia pipe covering, as both the pipe and conduit are gradually sloped to drain into the sewer system. Under the conduit was placed a 3-in. drain of ordinary farm tile, connected to the same sewer. To provide means for taking care of the expansion, three long right-angle bends were introduced in the pipe line, located in spe-

Interior of Roundhouse, Bloomington, Ill., C. & A. R. R.



Another View of Boiler Washing Apparatus.

Mann Spreader with Both Spreading and Banking Wings Down for Service.

cially constructed manholes and with pipe anchors suitably located. At the lowest points of the system, traps were located for properly drawing of the water of condensation. Between the round house fan rooms the pipe is run in the main pipe tunnel and lateral branch system of trenching mentioned in the foregoing description of the round house equipment. Another steam line of 3-in. piping is laid in a similar manner between the boiler house and the sand dryer by way of the blacksmith shop, and is extended to the cinder pit tracks for the purpose of thawing out engines in the winter time. This line comprises over 1,000 ft. of pipe underground, and about 450 ft. through the blacksmith shop where it is suspended from the roof trusses.

The precautions taken for protecting and draining the steam lines and conduit cannot fail to add materially to the life of the pipe and its covering.

Administration.

The work above described was designed and executed by Westinghouse, Church, Kerr & Co., as engineers and constructors, working under the direction of the railway officials.

Work was begun in the field in July 25, 1910. The cinder pit and one-half the round house went into operation Jan. 15, 1911, and the remaining half of the round house upon Feb. 10. The coaling station was ready for operation about April 1.

ORE DOCKS AT CLEVELAND.

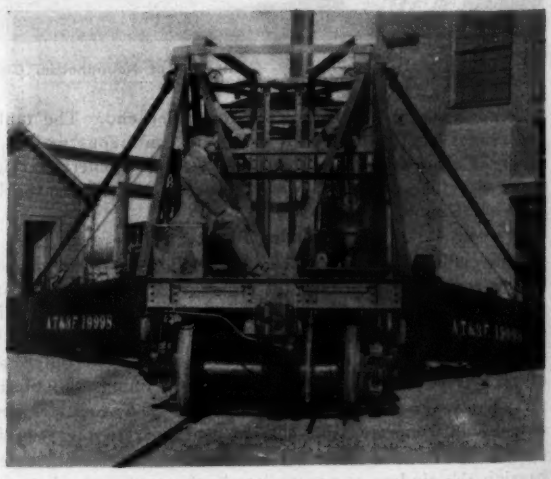
The latest step in that remarkable development of transportation on the Great Lakes which has made them the largest freight route in the world, carrying nearly half the world's output of iron, has recently been announced by the Pennsylvania R. R. Contracts have been let and work started on a gigantic ore handling plant at Cleveland, Ohio.

Between the three largest ore ports in the world—Cleveland, Ashtabula, and Conneaut—there has been a keen rivalry for some time, with one city ahead one year and another the next. Ashtabula received a push to the front when the Pennsylvania and Lake Shore roads spent $7,000,000 in improving its harbor, thereby doubling its capacity and making it accessible to vessels of the largest draft which had hitherto been unable to enter.

By the opening of navigation in 1912, the time called for in the contract for the completion of the new unloader, Cleveland will have facilities for handling ore on a larger scale than has been attained up to the present time. The plant will be located on the lake front a short distance from the mouth of the Cuyahoga River.

It is expected that this will handle two large carriers a day, or from 25,000 to 30,000 tons. Its four unloaders are to be equipped with 17-ton buckets. The largest in use at the present time hold 15 tons. The capacity of the weighing larry will be 50 tons, which is 15 tons greater than that of any previously built, and that of the receiving hopper will

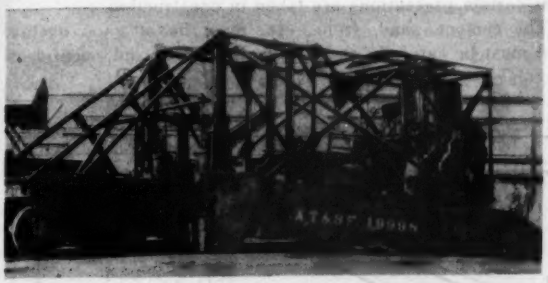
Rear View of Mann Spreader Showing Strut Bracing of Wings.



Front View of Spreader with Both Spreader Wings Down for Service.

be 65 tons. The motor equipment will be heavier and the speed of operation higher than on anything yet attempted. Provisions have been made not only for unloading the largest carriers now in existence, but also for those of greater width and draft that may be built in the future.

In connection with this improvement an area of 43 acres is being reclaimed by filling in between the Government Harbor Line and the Shore. This will provide a frontage on the lake of about 2,000 feet. The work includes the construction of a reinforced concrete dock 1,000 feet in length; foundations for ore handling machinery; a 15 ton ore bridge; a power house of 2,200 kilo-watts capacity; a haulage system for handling cars under the machines; a yard development for loaded and empty cars, and an undergrade crossing of the Lake Shore and Michigan Southern Railway.



The Mann Spreader with All Wings Folded.

Mann Spreader With Spreading Wing Down and Banking Wing Folded.

THE MANN SPREADER.

The machine shown in the accompanying illustrations is one of the most interesting in design of any yet built which have to do with the construction or maintenance of way departments of American railways. Its size, capacity, intricacy and yet simplicity of operation merits this interest.

The Mann spreader, illustrated in several positions, is in reality a bank shaper, bank builder, ballast spreader, grade elevator, ditcher, and flanger, all in one.

The machine in question was built and has gone into operation on the lines of the Atchison, Topeka & Santa Fe, which road has previously operated two machines of the same type. The Isthmian Canal Commission has successfully operated twenty-three Mann spreaders of different design for several years.

The first impression gained after superficial examination of the machine is one of extreme massiveness of construction and strength of parts. The weight of the wings would seem to make them unwieldy and their handlig a difficult proposition. All doubt, however, is at once dispelled after witnessing the machine in operation.

Each part is moved instantaneously at the will of the operator in the cab who has within convenient reach an air cock for each wing and for the ingathering plows.

An air reservoir of large capacity is located on the machine and is charged from the engine through the train line pipes. A cylinder of sufficient capacity is provided for each movement of the different parts of the machine and all motion is controlled from the operator's platform.

The car is of very heavy construction built to conform in every way to M. C. B. specifications. All strains are taken care of by reinforced bracing in the frames.

Attention is called to the system of strut bracing which is clearly shown in the rear view. These struts are placed in pairs one over the other in the same vertical planes. They are made telescopic and allow of the wings folding flat against the frame. The struts are on 16-in. centers and are made of 3½-in. extra heavy pipe and 3¼-in. cold rolled

End View of Greensburg Station, Pennsylvania R. R.

steel. The result is a perfectly solid bracing with entire freedom of movement in folding.

A machine of this kind is found most useful, and is kept almost constantly in operation on the different classes of roadbed maintenance or construction work which it is capable of performing. It has been stated that in the grading and reshaping of roadbeds its performance is more than equal to the efforts of six to eight hundred men. A few of the more important dimensions and weights are as follows:

Length over all .....41 ft.
Spread of main wings, adjustable to .....38 ft.
Spread of banking wings, adjustable to .....20 ft.
Height of main wings, adjustable 1 ft. above to 2 ft. below rail
Height of bank shaper wings, adjustable slope to 11 ins. below rail.
Total weight of machine .....950,000 lbs.

The machine is made and sold by the Mann-McCann Co., Fisher Bldg., Chicago, Ill.

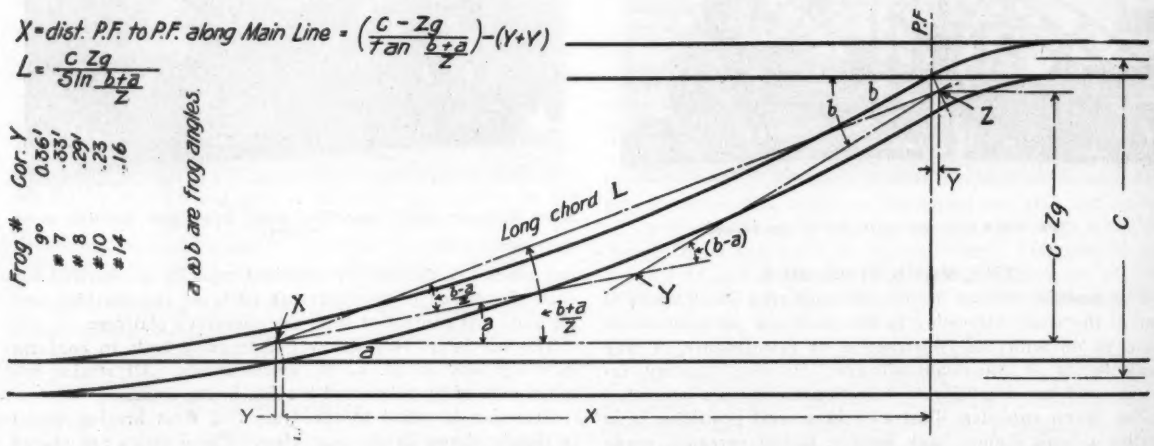
RUSTING OF STEEL IN CONCRETE.

The report of the science standing committee on the "Rusting of Steel Inside a Concrete Covering," which was presented at a recent meeting of the British Concrete Institute, stated that a circular was issued in 1909 by the Concrete Institute asking for observations on the question whether rusting of steel takes place when covered by concrete, and was sent to 1,000 engineers and others engaged in concrete construction.

Only 111 replies were received. Forty-seven contained results of definite observations, in which 26 cases of rusting had come under notice, and in 43 cases no rusting had been found.

As a result of these investigations the committee has arrived at the following conclusions: Reinforced concrete is as durable as plain concrete in any situation provided that certain precautions are taken in construction.

The cement, sand, stone, etc., must be of good quality, and must be carefully and thoroughly mixed and scientifically proportioned, so as to be practically waterproof and airproof. The mixture must be fairly wet and must be well punned into position to minimize voids. The aggregate should be as nonporous as possible, and no aggregate known to have a chemical action on steel should be used. The aggregate should all pass through a ¾-inch mesh. The concrete covering should never be less than ½-in., and with round or square bars the covering should not be less than the diameter of the bar. In structures exposed to the action of water or damp air the thickness of covering should be increased at least 50 per cent, or the size of the aggregate should be reduced so as to ensure a dense skin. Structures exposed to very severe conditions should have the concrete covered with some imprevious coating.



Crossover With Different Numbered Frogs.

CROSSOVER WITH FROGS OF DIFFERENT NUMBER.

Herewith is given the solution of a problem of a crossover between parallel tangents using unlike frogs (as, for instance, a No. 8 and a No. 10) with a simple curve between them.

The frog numbers and angles are known, as is also the distance between and gage of track. The triangle X Y Z must be isosceles in order to make the tangent distances X Y and Y Z equal, and these must be equal if a simple curve of minimum degree is used. The angle of intersection of the two frog lines is (b-a), since the frogs lay in parallel tracks (b-a) is the exterior angle of the isosceles triangle, and either of the opposite interior angles is equal to one-half of the exterior or $\frac{b-a}{2}$. Adding the frog number we have as the angle between the main line and the long chord

$$\frac{b-a}{2} + a = \frac{b+a}{2}.$$

The values of Y are equal to one-half $g \times \sin$ frog angle. Subtracting values of Y gives the distance between frog points along main track. Before reducing by these quantities we have the distance (parallel to track) between the intersection of center lines.

The intersection angle is (b-a). The tangent distance should be made so that the P. C. will start at the heel of the longest heeled frog (or back of the heel if desired).

The New York Central is in the market for 1,500 tons of bridge steel for the bridge at Oswego, N. Y.

The Delaware & Hudson is reported in the market for 500 tons of rails.

The Pennsylvania has ordered 5,000 tons of structural steel from the Fort Pitt Bridge Co.

The United Coal Mining Co., Terre Haute, Ind., is in the market for a quantity of light rails for immediate shipment.

The Hagerstown & Clearspring, Hagerstown, Md., has placed an order for 1,200 tons of rails with the Maryland Steel Co.

Greensburg Passenger Station, Pennsylvania R. R.

The passenger station of the Pennsylvania R. R. at Greensburg, Pa., is situated at Harrison avenue on the south side of the tracks.

The present grade crossing at Harrison avenue has been abandoned and in place of this crossing an undergrade bridge has been provided at Brushton avenue; a combined passenger and baggage tunnel has been built under the tracks at Harrison avenue which can be used by both pedestrians crossing under the tracks and for passengers to and from the Island platforms.

The station is designed in the Elizabethan style of architecture, constructed of brick with terra cotta ornamentation. The roof is covered with green slate. A clock tower seventy-one feet high has been built at the southeast corner of the building; the clock dials, four in number, are 5 ft. 6 in. in diameter and their height from the ground and the method of illumination will enable the numerals to be clearly read at a very great distance. A porte-cochere has been built over the driveway at the south entrance to the station.

The women's retiring room is finished in quartered oak; the walls are wainscoted. The toilet rooms are finished in marble, the floors are laid with Terrazza marble floor tile, the walls are wainscoted with marble and Italian marble partitions are used throughout. The emigrants' waiting room and emigrants' toilets are finished in oak, the floors are laid in cement and the walls are wainscoted with tile wainscoting.

Between the main station building and the retaining wall supporting the elevated tracks, is a passenger lobby 140 ft. long and 13 ft. wide. Leading directly from the lobby is the entrance to the passenger tunnel. The space between the station building and the baggage and express building will be used as an entrance to the tunnels and will be paved with cement and roofed over.

The east and west bound platforms at the track level are what is known as Island platforms with local and express tracks on each side; each platform will be 730 ft. long and about 30 ft. average width, paved with vitrified paving brick with cement

New Passenger Station at Greensburg, Pa., Pennsylvania R. R.

The interior of the station is designed in the Elizabethan style of architecture throughout and is divided into the main waiting room, women's retiring room, ticket office, Union News Co. room, men's and women's toilet rooms, and emigrants' room.

Special accommodations have been provided for emigrants using Greensburg Station as a transfer point between the main line and the Southwest Branch region, so that this class of travel may be segregated.

The main waiting room is finished in quartered oak throughout, the walls are wainscoted 5 ft. high and the floors are laid with terrazza marble tile; the roof is supported by ornamental wooden trusses, the clear height of ceiling being 28 ft. from the floor to the ridge of roof. The walls are plastered above the wainscoting with sand finished plaster, and painted in light buff tints.

curbs. The westbound shelter will be 560 ft. long and the eastbound shelter 460 ft. long. There will be two waiting rooms on the east and west bound platforms, each 60 ft. long and 10 ft. wide.

The Delaware, Lackawanna & Western is in the market for 650 tons of iron for its shops at Scranton, Pa.

The Missouri Pacific has ordered 1,800 tons of rails for use on the St. Louis, Iron Mountain & Southern.

The Southern has ordered 2,100 tons of rails from the Tennessee Coal, Iron & R. R. Co., and has divided 3,000 additional tons among other makers.

The Signal Department

RAILWAY SIGNAL ASSOCIATION.

The annual meeting of the Railway Signal Association was held in Colorado Springs, October 10, 11 and 12. Great interest is being manifested in the work of the Association, and a large number attended the meeting. The following committees reported:

Committee No. II—Mechanical Interlocking.
Committee No. III—Power Interlocking.
Committee No. IV—Automatic Block.
Committee No. X—Electric Signaling for Electric Railways.
Committee No. XI—Manual.
Special Committee—Promotion of Signaling Education.
Committee No. I—Signaling Practice and Standards.
Committee No. VI—Automatic Stops and Cab Signals.
Committee No. VII—Subjects and Definitions.
Special Committee—Storage Battery.
Special Committee—Recording Signal Failures.
Committee No. IX—Wires and Cables.
Committee No. XII—Contracts.

A report of the meeting will appear in a later issue.

THE CONTROLLING TOWER AT HAMBURG CHIEF STATION.*

An article was published in the "Zeitung des Vereins" of 1910 entitled: "The Controlling Tower at Larger Stations," which describes an arrangement that the author considers of much importance as regards the proper operation of an unusually large amount of traffic at large passenger stations. As towers for the centralized control of the traffic at large stations exist at very few places and hence are not generally known, it may be of interest to describe such a controlling tower which has already existed for some considerable time, so that it is possible to form an opinion as to the merits of this system.

A controlling tower has been in existence at the Hamburg chief station for the past year and a half. As the necessity for it and its system of operation arose from the needs of the actual traffic, we will give a short account of its development. There are great difficulties at the Hamburg chief station in the proper operation of the traffic and the regular working of the trains; these difficulties arise from the frequency of the trains, the heavy nature of the traffic and the many shunting operations in connection with mail cars which hamper the regular running of the trains. In order to overcome these difficulties as much as possible by suitable organization, one of the three signal towers was given the chief command. The intention was that the head in charge of this signal tower should, in the interests of the proper operation of the traffic, issue the necessary orders to the other towers and platforms, particularly for any changes in the regular working of the station, any regulation of the sequence of the trains; this is the usual practice in those cases in which there is such a chief tower. As long as it was a question of the ordinary amount of traffic, this system worked very well. Troubles and difficulties, which it was desirable to remove, however, arose whenever unusual events happened such as break-downs, derailments and snow drifts; also whenever there was a very heavy passenger traffic, as on holidays and on Sundays in summer. The head of the chief signal tower, just when he was expected to make suitable arrangements for the proper operation of the whole traffic was already fully occupied by his duties in his own tower, already complicated and increased by the existing irregularities, and he was unable to keep himself continually informed about the state of affairs at the other towers, and to act accordingly. It was therefore proposed that when there was an exceptional amount of traffic, a special well-trained station official should be sent into the chief signal tower in order to control the whole of the traffic. This system was, however, given up because it was found that a signal tower was not a suitable place for such a purpose. From such a place it was possible to obtain a view only of the block section in the immediate neighborhood and its tracks and signals. Continual telephonic communication was necessary in order to know what was happening on the other block sections, and in this way much time was lost. The ordinary work of the signal tower already made considerable demand on the telephonic equipment of the tower. The official who was to manage the traffic was disturbed and had his attention distracted by the speaking and calling to each other of the signalmen. It was therefore decided to retain the system of a chief tower only in the case of the ordinary regular working, and to establish a special controlling tower for use under extraordinary conditions. The experience acquired during past working was taken as basis, and the following principles were laid down: (1) A special room must be provided for the controlling place, and only used for that purpose. It must be in such a position that the official in charge cannot be disturbed by the public or by other employes. (2) The place must command a view of as much of the station as possible, for it is possible to obtain a quick grasp of the state of affairs and of their progress only if a good view of them can be obtained; much time is lost if inquiries have to be made by telephone. It is especially necessary that all the station platforms should be visible. (3) The official in charge must have direct telephonic communication with all the important points of the station and also with the important stations in the neighborhood. (4) The controlling tower need not always be occupied. It is only occupied and used when special conditions make it necessary, and then by the station master on duty who is specially qualified for this post by his official position and by his knowledge of the whole station.

The controlling tower at the Hamburg chief station is at the glass apron at the south end of the main hall. The floor-space of the tower has an area of 9 ft. 10 ins.; the floor-level is 43 ft. 8 ins. above rail-level. The walls of the tower consist of clear glass plates; one wall is formed by the glass apron itself. The position of the tower is such that it commands a good view over all that part of the station which is comprised within the main hall in which all the passenger and service platforms are located, and through the glass apron over the south and east approaches of the station and the block sections located there, as well as the signal towers; also over the mail sidings and switches, between these two towers, the tracks connecting the chief station with its locomotive and carriage sheds, the switches and tracks at the entrance to these sheds, and over part of the four-track section to the Hamburg port station. As regards the tracks and sidings of the chief station itself, there is only the block section at the north end of the station which cannot be seen, as the station building which is at right angles to the track limits the view in that direction. All signals except the home signals of the last-named section can be seen from the controlling tower or at least an optical duplicating signal shows how they stand. The controlling tower

*Bulletin of the International Railway Congress.

is equipped with a telephone and an intercommunication switch by which it can be placed in direct communication with every platform and every signal tower, with the station office, the inquiry office and the telephone office. Through the telephone office communication can be otbained with the other telephone call-boxes in the chief station and also with the chief neighboring stations without further switching. The loud-speaking telephone is on a cord 9 ft. 10 ins. long, so that it is possible to use the telephone from any point in the room; this has proved very satisfactory for the prompt answering of questions which make it necessary to look up something. All the service time-tables and particulars are in the controlling tower, including the graphic time-tables of the neighboring sections, the special station orders for the period in question (preferably in a graphic form), the orders concerning the marshaling of the trains, and particulars of the locomotive and train men available.

The controlling tower is only occupied when greater irregularities occur or are likely to occur, and it consequently seems advisable in the interests of regular working to manage the whole train service from one point. It is only occupied in case of accidents, derailments, snow drifts, break-downs in operating the electric line Blankenese-Ohlsdorf and similar unusual events, making it necessary to take special measures such as the organization of a provisional service, or the diversion of the traffic; also if there is a very heavy passenger traffic, as on special holidays, on Sundays in summer, at the beginning and end of the summer holidays, and on other special occasions. The official in charge has to decide whether and for how long the controlling tower is to be occupied. Orders are issued beforehand that it is to be occupied either continuously or during certain hours.

As soon as it is occupied the occupier notifies all the signal towers, platforms and offices. The termination of the occupation is notified just as widely.

The experience gained in course of time led to additions to the duties originally entrusted to the official in charge of the controlling tower; they are now as follows:

(1) He has to watch the whole train service in order that the station installations may be utilized to their fullest capacity; he has to regulate them by deciding when any alterations in the regular working are to be made; what tracks are to be used in such cases for the trains; which of several trains which interfere with each other is to run first; and whether and when any alteration is to be made in the sequence of the trains. In order to enable the controlling tower to do this, it receives advices from the telegraph offices, from the signal towers and if necessary also from the suburban stations, and is informed by telephone of the lateness of any trains, or of any other relevant circumstances.

(2) He has whenever it is necessary for the proper maintenance of the train service, to decide whether any alterations are to be made in conducting the shunting operations on the main lines and if so, what and when.

(3) He has to look after the marshaling and if necessary the preliminary heating of extra cars; if it appears probable or certain that the trains will have to be of greater length, he has to take the measures necessary for preventing any lateness of the trains arising from their greater weight.

(4) He has to make preparations for running special trains which may be made necessary either by the amount of traffic or by any disturbances in the regular service, and has to decide which train and which locomotive are to be used, and what men are to be employed on them.

(5) He has to arrange the locomotive service, if alterations are made necessary in the ordinary service by the break-down of any locomotives or by changes in the trains.

(6) He has to arrange the work of the men when any extra work has to be done, or if they cannot work in their regular shifts.

(7) He has to provide for any requirements of the suburban stations as regards the supply of trains and locomotives with the necessary staff for the return of Sunday excursionists.

(8) When the staff has an unusual amount of work to do, he has to see that employes are present wherever necessary.

(9) He has to draw the attention of the employes to any peculiarities in the running of the trains, in the arrangements for the passengers, in the carrying out of the switching, operating, etc.; he has to supervise the men and see that the work is done; he has to remedy any deficiencies or irregularities at once.

(10) He has to answer all inquiries from the signal tower, platforms and other station offices, on the subject of traffic and train operation.

The controlling tower at the Hamburg chief station has given satisfaction in every way during the one and a half years of its existence. It must be admtited that the duties which the official in charge of the controlling tower has to attend to, are rather extensive, and only well-trained officials are capable of carrying them out. On the other hand, the official benefits by the suitable location and arrangement of the tower. As he can see everything with his own eyes, can watch the train movements and the switching operations, can see to what extent passengers crowd the platforms, and is always in a position to be able to issue suitable orders. As he uses the telephone himself, misunderstandings in consequence of wrong transcription are excluded and time is saved. He has all the papers, etc., ready to hand, so that he can at once turn up anything in case of doubt. Every employe knows where he has to apply in order to obtain correct information. It is also of importance to the other points and neighboring stations that there is a given point at the chief station with which they can make arrangements without loss of time and can come to an understanding. It has been found that this system of a controlling tower results in a better utilization of the station installations and greater efficiency. There has been no lack of special occasions when the practical merits of the system could be gauged. We need only mention the German national shooting competition held at Hamburg in 1909, the agricultural exhibition in June, 1910, and quite recently when the natural gas caught fire in Neuengamme. It has always been found that the controlling tower contributed much to the proper operation of a very heavy passenger traffic.

The question as to whether it would be advisable to install such a tower at every large station, and whether general principles can be laid down as to its arrangement cannot be decided off hand. The necessity of such a controlling tower will always depend on the whole arrangement of the station and on its peculiar features, as well as on any failure of the chief tower system, if such exists. The work and the functions of the controlling tower will always have to be suited to the individual traffic of the station concerned, as well as on the location and arrangement of the cabin itself.

The Boston & Maine has ordered 600 tons of bridge steel from the Boston Bridge Company.

The Baltimore & Ohio has placed an order with the Carnegie Steel Co. for the rolling of 6,500 tons of standard steel rails. The rails are to be used in improvement work to be done early in the spring, and it is said the order will shortly be followed by an even larger one from this road.

The Maintenance of Way Department

Roadmasters and Maintenance of Way Convention

The twenty-ninth annual convention of the Roadmasters' and Maintenance of Way Association was held in St. Louis Sept. 12-16 at the Southern hotel. The opening session was called to order at 11:00 a. m., Sept. 12, with President T. Thompson, roadmaster of the Atchison, Topeka & Santa Fe, in the chair. Addresses of welcome were made by the mayor of the city and by President B. F. Bush of the Missouri Pacific.

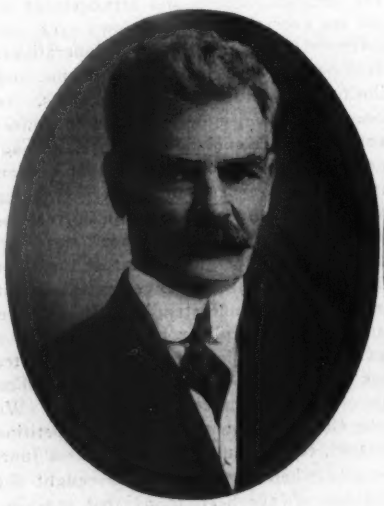
Mr. Thompson, who opened the meeting, said in part: "Our purpose in assembling here is to educate ourselves by exchanging ideas and discussing methods of track maintenance. In order to obtain the greatest benefit from the meetings it is necessary that the members take an active part in the discussions. Roadmasters should keep in touch with new devices and methods tending to put track maintenance on a higher plane. Standards gotten out by the railways should be studied and closely adhered to. This convention not only benefits the individual members, but also the railways, which receive the fruits of our efforts in increased efficiency in the track department."

B. F. Bush, president of the Missouri Pacific, in his address said: "The maintenance of way department is usually the first to feel the effects of retrenchment and curtailment of expenses. Difficulties are encountered by the roadmasters during times of business prosperity, but these are greatly increased when the work has to be accomplished with short appropriations and reduced forces. However, it is not only among the roadmasters that curtailment is felt, but all through the engineering and operating departments. The roadmasters and maintenance employes have a great duty to perform at the present time in getting in touch with farmers or others who are patrons or possible patrons of the road. By cultivating a friendly relationship with these people, much may be done towards counteracting the present antipathy toward the railways."

Secretary W. E. Emery read letters from a number of general managers who expressed their willingness or desire that roadmasters attend the convention wherever possible. The names of eighty-one new members were then read by the secretary and were voted in unanimously. A number of additional new members joined during the progress of the convention. The attendance was about ninety, with about half as many guests. Following the acceptance of the new members, the committee reports were taken up.

Manganese Frogs and Crossings.

This committee based their report on extensive personal experience with manganese steel frogs and crossings in use on the various railways in and near Chicago. Their report was as follows: We find at points where manganese has been in use for a number of years, as far as we have seen and have been able to obtain information that manganese frogs and crossings have proven a success. The maintenance of such frogs and crossings has been greatly reduced by eliminating cost of bolts which are ordinarily used in the bessemer rail frogs and crossings. Another advantage is a big saving in frog and crossing timbers which are ordinarily ruined, due to re-spiking and rail cutting.



A. M. Clough, President.

T. F. Donahoe, First Vice-President.

M. H. Connolly, Second Vice-President.

Officers of the Roadmasters' and Maintenance of Way Association.

One of your committee had installed two No. 10, 85-pound manganese frogs which have been in service under the heaviest kind of traffic on switching leads since Dec. 8, 1908. One of these frogs is still in the track and will wear another year. The other frog was removed Feb. 1, 1911, on account of the toe and heel of the bessemer rail being flange worn. The manganese part of the frog is still in good condition and would wear out another set of rails.

Where these frogs are in use the traffic is of the heaviest kind,—continuous switching night and day. The longest service obtained from the ordinary bessemer rail frog was 30 days. In the same time that the manganese frog has been in the track it would have worn out 26 bessemer rail frogs, each costing about $29.00, while the cost of the manganese frog was about $94.00. In addition to this there was no cost of maintaining the manganese frogs up to date.

We recommend the extensive use of solid boltless manganese frogs and crossings for heavy switching leads and other places where traffic is heavy and also for crossings for high speed main line tracks.

Committee: M. Burke (C. M. & St. P.), chairman; J. J. Duffy (C. & I. W.), T. Thompson (A. T. & S. F.)

Mr. Burke added that since the report was written up one of the above-mentioned frogs had been in use an additional seven months, making 33 months in all.

In discussing the paper Mr. Clough said that the N. Y. C. & H. R. R. R. were using a number of manganese frogs on side tracks but that they were not yet ready to trust them in main lines under heavy traffic. Mr. Clough expressed a desire to hear from members who had frogs under main line traffic, and said that he hoped the convention would find it safe to recommend their use for such conditions, as he believed that great economy would result.

Mr. Grills (Grand Trunk) gave an instance of manganese crossings under his supervision, which had been in service four years and which showed slight cracks in the flangeway. These cracks, however, did not appear to be spreading, and the frogs were still safe and in use.

Mr. L. C. Ryan stated that a great many of the roadmasters on the C. & N. W. were thoroughly convinced of the great merits of manganese frogs, and they were ordering these frogs for practically all renewals, both for crossings and switches and that until recently these frogs had been sent out in accordance with requisitions. He stated, however, that the officials had recently called a halt, as they did not wish to tie up money in too many of these frogs until further results justified them in doing it.

W. R. Thompson (Cent. of Ga.) stated that manganese frogs in his territory have shown a service of 6 to 1 compared with the ordinary bessemer steel frog, but that he doubted the advisability of their use in main lines as a heavy blow would be given when the wheels passed from the softer rail to the manganese.

T. Thompson (A. T. & S. F.) said that he was using some manganese frogs which were giving highly satisfactory service, and that the maintenance on them had been practically nothing. He said that the ties lasted much longer than those under the bessemer frog, due to the fact that there was less jar in passing over the point, and that the frog being stiffer transmitted the wheel loads over a larger number of ties.

By vote of the meeting the committee recommendation was changed from solid boltless manganese frogs, to manganese frogs. The report was adopted in this form.

Use of Soft Ties.

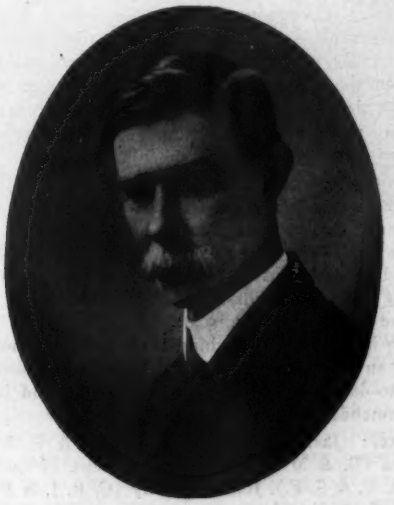
The committee stated that under the classification of soft ties they thought it proper to consider cedar, pine, gum and similar woods, and for hard wood, oak, beech, hickory, hard maple, ash, pecan, honey locust, etc.

The committee confined their report to cedar and oak as being typical examples of soft and hard wood. The report was as follows: In discussing any feature of track construction we consider safety to be the first consideration. The safety of the track outside of the grade is assured by three things, line, surface and gauge, while there are three elements that produce them, the ballast, ties and rail. From the ballast we get the surface, from the rail the line and from the tie the gauge, each, of course, being in a manner influenced by the other. In the main track with heavy traffic and modern equipment we are striking at the very foundation of the safety of our track in attempting to use soft ties no matter what their relative cost, for the reason that one train may turn over many rails in apparently sound ties.

Under safety we must think of other tracks as well as the main track since damage to equipment or loss of human life is a matter of concern to us; no side track of general use should be so constructed except so that engines of the heaviest class can use it with perfect safety. This is especially true of ladder tracks and switching leads in important yards and passing tracks along the main line where a derailment may mean a yard blocked for an indefinite time and the whole system hampered by one weak link in the chain.

We hear much of cheap ties on new branch lines where the argument is presented that the traffic is light and the cedar tie on account of its long life will give all the service that is necessary for years to come when, if the line proves profitable and new business is developed, a more permanent construction can be furnished. The objection to this is that the sudden development of coal mines or other industries may incapacitate the line a short time after its completion. Your committee investigated among other cases one track 34 miles long that was built of gravel ballast, cedar ties and 65-pound rail that answered every purpose for 13 years, when almost in a night a stone field was developed, coal was diverted from another line and merchandise runs were sent over this line on account of better grade than the old

L. C. Ryan, Secretary.



James Sweeney, New Member Board of Directors.

Officers of the Roadmasters' and Maintenance of Way Association.

line. One hundred thousand capacity steel cars and the heaviest engines replaced the little coal train, and the cedar ties were found entirely inadequate to the demand put upon them. The first means of improving conidtions was to replace in each mile 1,500 cedar ties with oak ties the first year and to change out the balance as fast as possible. The gravel ballast stood the strain as did also the light rail and after five years of heavy traffic the same rail is still in service and in good condition. At the time the cedar ties were taken out they were as sound on top as when put in although slightly decayed from the bottom. Under the rail they were crushed from one inch to half way through and cut to pieces by frequent respiking to restore the spreading gauge. At the time this line was built the soft ties cost 50 cents each and oak ties were worth only 35 cents each, the cedar ties being selected because they were known to be of long life and there was no apparent reason why they should not give all the service that would be demanded of them for 25 years. When built, all the ties in the track were protected by light tie plates, which were the heaviest plates on the market at the time. These tie plates proved of very little benefit when the heavy traffic was put on the line.

In repair yards we have conditions that are ideal for the soft ties. Here we have nothing heavier than a switch engine and low speed on all tracks. The long life of the tie is a matter of economy both in the first cost of the tie and the lesser expense in renewing the tie. Renewals are especially costly where the ground has been packed down by the men working in the yard. We also find good use for the soft tie in empty track at coal mines, storage tracks and similar tracks where the traffic is light enough that we are justified in using light rail and inferior ballast.

Local conditions and not good engineering have made the soft tie a factor in railroad construction, where it serves its time until pushed out by its hardier brother. When fast trains and heavy trains follow the converted switch engine and freight must move on schedule time to arrive at growing terminal points, there is no place for a weak unit in the machine of railroad operation and if the use of soft ties in switches, switching leads and track means the making of an inferior tie one of the links in the construction of an up-to-date railroad, it is not economy and its use is not recommended.

Committee: Jas. Sweeney, chairman (C. & E. I.), J. W. McManama (B. & M.), W. H. Heath (Cent. of Ga.), Oscar Gabriel (A. T. & S. F.), John McNulty (C. R. I. & P.), Chas. Newberg (C. & N. W.).

The discussion on this report brought out some very great opposition to cedar as a material for cross ties. C. M. Greene (C. R. I. & P.) said he thought cedar ties unfit for use in any track.

A motion was carried condemning the cedar tie as unfit for use in switch leads or main track under heavy traffic. The report was revised to recommend that ties softer than yellow pine should not be used in main track under heavy traffic and that yellow pine is suitable for light traffic tracks. With these changes the report was accepted.

How to Remedy Soft Spots in the Roadbed.

This was a valuable report and brought out extensive discussion. It is given verbatim on another page of this issue.

Committee: M. Henry, chairman (C. & E. I.); W. E. Strother (T. & W.); Henry Klein (C. & A.); P. H. Gaffney (Mo. Pac.); J. A. Roland (C. & N. W.); A. B. Richards (L. E. & W.).

M. F. Duff (A. T. & S. F.): We have tried tile in soft clay fills with unsatisfactory results. The tile became displaced or broken. Cross ditches filled with slag and cinders drained this fill satisfactorily.

J. P. Warren (St. L. & W.): We have had a good deal of trouble with slides on fills, and find that they are due to three causes: Borrow pits left too close to the fill; hard packed runways made by scrapers; underlying sloping strata of limestone on which the soil slips when wet. We have remedied these defects by filling in the borrow pits; by scarifying the surface of old runways; and by blasting the surface of the rock strata.

A very spirited discussion was entered into on the merits of bell mouth or plain, porous or glazed tile, with the arguments favoring bell mouthed glazed tile. It was conceded that tile should be covered with a heavy layer of stone or cinders.

Mr. Grills made the point that old fence or car boards should be used made into a triangular trough with broken joints, and placed beneath the tile, as this construction largely prevents tile from being displaced.

Changes were made in the report as follows: When soft churning material is removed from a grade the hole should be refilled with a harder material than ordinary soil; vitrified or glazed tile should be used instead of porous tile. An amendment was added that more attention should be given to the construction of railway grades to decrease the possibility of soft spots developing. The report was adopted.

Motor Cars for Section Use.

The report on this subject emphasized the fact that simplicity of construction and operation is necessary on a motor car for use by the section men, since the latter are not mechanics and must in general be able to make repairs and operate the cars. D. E. Lynch, chairman, stated that the C. B. & Q. had put in service a Fairbanks-Morse gasoline car and that the use of this car enabled the railway to increase a section from 6 to 12 miles, eliminating one 6-mile section. It is necessary that the motor cars have sufficient power to transport heavy loads of men and tools against strong winds and up heavy grades. In the case of the section car as mentioned above, one gang now does the work better and more easily than two gangs did it before. The saving in wages of one section foreman alone at $65.00 per month has amounted to $1,365. This car is equipped with handles for use if the power gives out, and this is a very desirable feature.

The committee on this report: D. E. Lynch, chairman, (C. B. & Q.); John Heshion (Mo. Pac.); A. L. Klein (A. T. & S. F.); Warren Peachey (E. & T. H.).

C. King (Long Island): The committee has received a number of letters testifying that motor cars are economical for branch lines or lines of light traffic.

J. P. Warren (St. L. & W.): The track department should be furnished with motor cars for section gangs. I think, however, that the length of sections should not be materially increased. Some roads have already gone too far in lengthening of sections after motor cars are introduced, with a resultant drop in efficiency. We are entitled to these cars for their saving of time with a resultant betterment of the track, but should not be compelled to submit to reductions in maintenance forces, as these were now too small in a great many cases.

Mr. D. Foley (Michigan Central): I am in harmony with the spirit of the previous speakers in regard to upholding the quota of track forces. Further, I propose that, in view of the increasing duty of the track under a constantly growing tonnage, the sections should be shortened and more men employed. If necessary I would prefer to keep the old pump cars and increase their efficiency by putting them generally in better repair. The work of maintaining track is all the time increasing and I do not see how I can dispense with even a single one of my foremen. A foreman, in my estimation, is worth two good men anywhere they

could be put. I would prefer under all circumstances to keep every one of my section foremen.

The report was adopted, approving the use of motor cars for section use.

Concrete and Steel Ties.

Concrete and steel ties have been experimented with on many roads and have shown a number of defects. Concrete ties in particular are heavy, and this weight increases the cost of handling in the initial installation and in subsequent maintenance. Steel ties must be insulated in automatic signal territory; the insulation is expensive and difficult to maintain. The types of fastenings used are many of them unsatisfactory. The following points should be considered in deciding for steel or concrete ties: (1) Original cost; (2) Cost of handling, due to weight and shape; (3) Safety of the fastenings; (4) Durability and efficiency of insulation (for steel ties) during moist weather, on varying roadbeds. A steel or concrete tie of greater width and less depth than the wooden tie should answer the purpose, where it is decided that either is practical. This construction would give wider bearing surface for the rail and greater bearing surface on the ballast, with fewer number of ties per mile for a given amount of material.

Delegates at the Roadmasters' and Maintenance of Way Convention.

Committee: L. C. Ryan, chairman (C. & N. W.); P. J. McAndrews (C. & N. W.); F. R. Layng (B. & L. E.); John D. Boland (Union Pac.); F. D. Harrigan (Pere Marquette); John O'Leary (C. & A.).

L. C. Ryan (C. & N. W.): The steel ties investigated cost $2.50 to $3.50 and the estimated life was 25 to 35 years. The cost of our oak ties is now upwards of $1.00.

W. T. Muff (A., T. & S. F.): We have in use 106 insulated steel ties. These are on a short curve and steep grade, and under heavy traffic. It has been two months since the track was surfaced at this place and the ties have not slewed nor required any work in that time.

D. Foley (Mich. Cent.): We have experimented with three types of concrete ties, two of which have failed. The third type is still in the track and appears to be giving satisfaction. It is my opinion that concrete ties can not be used under main line traffic, but they may be satisfactorily developed for side track and yards.

A. C. Rupp (C., C., C. & St. L.): We have a mile of Carnegie steel ties in our track. A derailment occurred which destroyed the wooden ties, but the wheels passed over the steel ties without damaging them.

The report was accepted as information.

Treated Ties.

The committee on "treated ties" reported as follows:

Almost the entire attention of every railroad man in charge of maintenance or tie supply, has been directed towards preparing ties for the greatest resistance to decay and the proper handling of the ties to render the treatment most effective. The point to be brought before this association, in our opinion, for the most serious consideration, is the lasting qualities of the different kinds of treated ties. The different kinds of timber, the difference in climatic conditions and the best method for the least money in handling and taking care of treated ties from the time we receive them in the cars until the time they should and are properly placed in track are also important.

In many cases, owing to various kinds of timber, and other causes, the amount of oil admitted into the tie varies considerably.

We are of the opinion that when creosoted ties are received from the plant, they should immediately be put in the track, particularly if the road bed is gravel, rock ballast, burnt gumbo or of such nature that track gets a box dressing and tie is practically covered up and surrounded with material to prevent evaporation to any great extent.

Yet we must admit that in many events and for reasons unnecessary to explain it is impossible to get ties in track immediately after receiving, so we now arrive at the next step—piling ties.

Piling ties has been discussed at some length, and particularly piling ties treated with creosote; the closer they are piled the better. But one very important question which confronts us is the expense of handling. As soon as unloaded they should be piled on suitable high ground, and care should be used on single track whenever possible, not to unload on the same side as telegraph wires, and if so, not closer than fifty feet from telegraph poles, crossing or station signs, to eliminate the danger in case of fire.

Unlike the untreated or zinc chloride tie, we do not consider it necessary to place old ties on the ground under creosoted ties. The sod should be removed from around ties for a distance of at least fifteen feet to prevent fire. The number of ties unloaded along the section depends on the number of ties per mile to be placed in track, and that to some extent should govern size of the piles. But most railways have a standard of piling creosoted ties by placing two ties as sleepers and then piling them in close layers, cross box style with about 77 or 88 ties in each pile.

We believe that an efficient and economical way of piling ties is to put two ties on the ground for sleepers, and then pile all the rest of the ties at right angles to the sleepers, close together, and in a triangular or inverted V-shape pile.

Ties treated with zinc chloride, should be piled so as to be exposed as much as possible, to bring about rapid absorption, and be practically free from moisture before being placed in track. The drier the wood becomes after treating,

the more thoroughly it becomes impregnated with the zinc chloride, and the less the tie suffers from climatic conditions. If imperfectly seasoned zinc treated ties are put in a soft road bed in a wet season, or in a damp country, there is a tendency to wash away and cause the chemicals to evaporate very materially.

J. H. Lynch, Chairman.

The discussion on this report brought out the fact that treated ties should be seasoned before being put in the track. The discussion branched off onto the protection of treated ties from mechanical wear. An instance was given of the use of ⅜-inch wooden shims used instead of tie plates. These shims are made of the same width as the base of the rail, and long enough to extend from edge to edge of the tie. This system of tie protection has worked out satisfactorily in renewals out of face, but not very satisfactorily in spotty renewals. These wooden shims cause moisture to be retained between the tie and the shim. There was a good deal of opposition manifested to the zinc treated tie, as many present testified to the fact that spikes had corroded and been destroyed in a few years in zinc treated ties.

There were many dissenting opinions on the effect of zinc chloride on the spikes. Mr. Camp made the point that this difference in results might be explained by the fact that zinc chloride is made by treating zinc with hydrochloric acid. If an excess of this acid is used the preservative will attack metals, while if there is plenty of zinc, no bad effects are experienced. L. C. Ryan related finding a number of treated red oak ties which were very treacherous, looked sound on top, but had entirely rotted underneath in four years. It was suggested that this was caused by insufficient seasoning before treatment. A member estimated from his experience that a properly creosoted tie would last three times as long as the same tie untreated. The following motion was passed: We recommend continuing the use of treated ties until further experiments have been made, and additional results obtained.

Emergency Stock of Tools.

The committee reported as follows:

The prevalent practice of permitting section foremen to carry surplus tools and track material in stock in the tool house results in a large amount of material being stored in this way which represents idle investment. The chairman of the committee suggests a method for eliminating this practice, which is agreed to by all the members of the committee. The suggestion includes the following points:

1. Suitable buildings should be provided at the roadmaster's headquarters in which a specified number of surplus tools and a considerable amount of small track material, such as bolts and spikes, could be kept. This material could be secured by the foreman upon requisition, and if desired, the roadmaster's clerk could keep a record by sections of the material furnished each foreman.

2. Worn out tools which cannot be repaired by the foreman should be sent to headquarters to be exchanged for new ones. This will enable the roadmaster's department to know what disposition is made of old tools. They can be inspected under the roadmaster's supervision and those which cannot be repaired shipped to the storekeeper, and the parts which may be of use sent to the shop for repair. This would cause all old tools from a roadmaster's territory to be sent to the storekeeper in one shipment instead of many as at present.

3. The roadmaster can make one or two monthly requisitions on the storehouse for tools and material, securing on this requisition a 30 days' supply. This eliminates the necessity for the numerous requests by section foremen.

Committee: J. H. Jones, chairman (A. T. & S. F.); J. E. Sampson (B. & M.); B. A. West (A. T. & S. F.); J. T. Martin (D. T. & I.); Wm. J. McDermot (C. & N. W.).

New Appliances.

This committee includes in its list of new appliances some devices which are not entirely new, but which have undergone such radical changes in recent years that they deserve attention at this time. The following devices are included:

1. Shoulder tie plates.—The committee recommends shoulder plates 7½ ins. x 9 ins., extending 2¼ ins. beyond the base of the rail on the outside and 1¾ ins. on the inside, the plate to be ½ in. thick at the outside edge of the rail base, tapering to 7/16 in. at the inside edge; the plate should be corrugated or flanged on the bottom to prevent rattling. The use of tie plates is recommended for main line tracks and switch leads and turnouts where traffic is heavy.

2. Rail anchors.—The anchor with the fewest number of parts is recommended, as it is easy to apply, can be readily removed when the rail is changed, and is applied without loss or breakage.

3. Solid manganese frogs.—The use of solid manganese spring rail frogs under heavy traffic at high speed, and some form of hard frog on all heavy traffic switching leads is recommended.

4. Manganese steel points.—Solid manganese steel or a similar material is recommended for use in switch points, the full length of the point to be made of the special steel where traffic is heavy enough to warrant the expense.

5. Switch slide plates.—Gage plates should be at least ¾ in. x 6 ins., insulated when necessary and turned up at both ends to form a shoulder for bracing. Slide plates should be 12 ins. long and turned up at the ends. Braces should be placed on every tie from the gauge plate to the heel of the switch point. Special plates punched to order should be used on joint tie back of the heel of the switch point to the point where standard tie plates can be used. A malleable iron joint casting should be made to fit between the stock rail and the switch point, to be bolted to the stock rail.

6. New automatic switch stand.—Automatic switch stands are recommended for yards to prevent derailments caused by running through switches equipped with rigid stands.

7. Motor hand cars for section men.—The use of gasoline motor hand cars of simple two-cycle design, weighing between 650 and 700 lbs. is recommended.

8. Screw spikes.—The use of screw spikes is favored.

9. Hydro-carbon for snow melting.—The use of hydro-carbon, a highly inflammable liquid, for melting snow around switches, by pouring out the liquid and setting fire to it, is mentioned as an experiment worth consideration.

10. Ballast sprinkler.—A car equipped for sprinkling stone ballast is a device which merits attention.

11. Sod line trimmer and roller. A new sod line trimmer and roller has been devised which appears to be a great labor saver.

12. A railway ditcher.—Attention is called to a ditcher which has all the qualities of a steam shovel and can be used for sloping and ditching wet cuts, removing slides, handling rock, timber or ties, and can also be used as a light wrecking crane. It can be handled on the deck of an ordinary flat car, or can be placed on the ground and used in the same manner as the steam shovel. It is recommended for stripping the top soil from gravel pits, and it is thought that it could be more widely adopted.

Committee:—A. M. Clough, chairman (N. Y. C. & H. R.), D. Foley (Mich. Cent.), M. H. Connolly (Cinn No.), T. Thompson (A., T. & S. F.), J. M. Meade (A., T. & S. F.), A. W. (C. & N.-W.).

This report was discussed by paragraphs. The discussion was not very extensive, and the report was adopted almost

without comment. This ended the regular committee work of the association. The supply men were given the floor for a short time, after which the following newly elected officers were installed by Mr. Kerwin:

President, A. M. Clough, New York Central & Hudson River, Batavia, N. Y.; first vice-president, T. F. Donahoe, Baltimore & Ohio, Glenwood, Pa.; second vice-president, M. H. Connolly, Cincinnati Northern, Van Wert, Ohio; secretary-treasurer, L. C. Ryan, Chicago & Northwestern, Sterling, Ill.; member of executive committee, James Sweeney, Chicago & Eastern Illinois, Danville, Ill.

The next convention will be held at Buffalo, N. Y., September 10, 1912.

Following the installation of officers, the report of a specially appointed committee on resolutions was read by W. M. Camp, chairman.

A number of talks were given favoring the periodical meetings of section foremen and roadmasters, and of division roadmasters. Remarks were also made commending the employes' magazines which are being published by many railway systems.

A social feature of the convention was the formation of a ladies' auxiliary. This will undoubtedly increase the interest in these conventions and cause more of the roadmasters to bring their families to the yearly meetings.

EXHIBITORS AT THE ROADMASTERS AND MAINTENANCE OF WAY CONVENTION.

The following firms had exhibits at the convention at St. Louis:

Adreon Manufacturing Co., St. Louis, Mo.—Clark tie plate; Security rail brace; Boss nut lock. Represented by E. L. Adreon, Jr., and D. R. Niederlander.

Ajax Forge Co., Chicago.—Ajax manganese steel one-piece guard rail; Ajax steel rail braces. Represented by F. B. Bradley and H. C. Hutchins.

American Hoist & Derrick Co., St. Paul, Minn.—Moving pictures of American railroad ditcher in operation. Represented by J. J. Cox and Edward Coleman.

American Valve & Meter Co., Cincinnati, Ohio.—Anderson interlocking switch stand; Anderson economy switch stand; Safety switch point lock. Represented by J. T. McGarry and F. C. Anderson.

Appleyard, G. T., Grand Rapids, Mich.—Appleyard and Robson compound railway tie. Represented by G. T. Appleyard and A .M. Robson.

Buda Co., Chicago.—Motor cars; track drills; track jacks; tool grinders; switch stands. Represented by S. T. Hatcher and T. H. Wheeler.

Continuous Frog & Crossing Co., St. Louis, Mo.—Model of continuous rail frog. Represented by William G. Brown and R. B. Pender.

Cook Standard Tool Co., Kalamazoo, Mich.—Track appliances and descriptive literature. Represented by Eugene Cook and E. Edelmann.

Chicago Pneumatic Tool Co., Chicago.—Rockford railway section and inspection gasoline motor cars; pneumatic tools; electric tools for drilling, grinding and for boring and inserting screw spikes in ties. Represented by C. E. Walker and E. S. Cole.

Fairbanks, Morse & Co., Chicago.—No. 26 Fairbanks-Morse section gang car; No. 28 and No. 30 Fairbanks-Morse inspection cars; forty-ton geared ratchet jacks; forty-ton Duff ratched forged steel hydraulic jacks; track jacks. Represented by Lorenzo Norvell, E. E. Penbray, A. T. Young, E. M. Fisher, D. J. Higgins and C. F. Fuggit.

Goldie, William, Jr., & Co., Bay City, Mich.—Samples of Goldie perfect tie plugs. Represented by William Goldie, Jr.

Hayes Track Appliance Co., Richmond, Ind.—Hayes derails. Represented by William Harding Davis.

Indianapolis Switch & Frog Co., Springfield, Ohio.—Models of solid manganese frogs and crossings and test bars of steel used; photographs of installation and complete line of blue prints showing details of construction. Represented by E. C. Price.

Kalamazoo Railway Supply Co., Kalamazoo, Mich.—General display of track devices. Represented by John McKinnon and Lewis O'Key.

Lackawanna Steel Co., Buffalo, N. Y.—Abbott rail joint plate; Abbott insulation joint; anti-creeper, double strength, equal resistance in either direction. Represented by A. H. Weston.

P. & M. Co., Chicago.—P. & M. anti-rail creeper; bond wire protectors. Represented by P. W. Moore, F. A. Preston, D. T. Hakberg and George E. Johnson.

Pennsylvania Steel Co., Steelton, Pa.—Design No. 160 Manard frog; Steelton positive switch stands; main line adjustable swtich stand; New Century adjustable and non-adjustable switch stands. Represented by Robert E. Belknap, N. E. Salsich, G. S. Vickery, W. H. Allen and E. Dwitt.

Rail Joint Co., New York.—Continuous Weber and Wolhaupter rail joints. Represented by William E. Clark, H. O. Holloway, Charles Jenkinson and W. J. Boyer.

Railroad Supply Co., Chicago.—Wolhaupter and Harriman spike plates and track bolts. Represented by M. J. Camerford and W. A. Dayton.

Railway Age Gazette, New York.—Copies of Railway Age Gazette and Signal Engineer. Represented by John N. Reynolds and H. H. Simmons.

Railway List Co., Chicago.—Copies of Railway Engineering and Maintenance of Way and the Monthly Official Railway List. Represented by W. E. Magraw, L. F. Wilson and K. L. Van Auken.

Ramapo Iron Works, Hilburn, N. Y.—Switch stands; solid rolled shoulder tie plates; enameled interlocking switch stand targets. Represented by W. C. Kidd and Arthur Gemunder.

Reinforced Rail Joint Co., St. Louis, Mo.—Compromise and insulated joints. Represented by H. F. Reelch, William G. Brown and R. B. Pender.

Sellers Manufacturing Co., Chicago.—Sellers Anchor Bottom tie plates. Represented by J. T. Markham and L. S. Gordon.

Southern Railway Supply Co., St. Louis, Mo.—Saunders car stopper. Represented by E. Catlin, Jr., and L. E. Truxler.

Templeton Kenley Co., Ltd., Chicago.—Simplex track jacks. Represented by A. E. Barrow.

U. S. Wind Engine & Pump Co., Batavia, Ill.—Switch stands. Represented by C. E. Ward.

Universal Metallic Tie Co., Salt Lake City, Utah.—Universal metallic ties. Represented by B. S. Rupp.

Vaughn Rail Support Co., St. Louis, Mo.—Samples of Vaughn rail support and model of Champion concrete fence mold. Represented by Theodore E. Vaughn and J. C. Sterling.

Verona Tool Works, Pittsburg, Pa.—Diamond stone tamping bar; master gauge for testing track gauges. Represented by Henry Fischer.

At a meeting of the Track Supply Association, the following officers were elected for one year: President, W. C. Kidd, Ramapo Iron Works, Hillburn, N. Y.; vice-president, A. H. Weston, Lackawanna Steel Co., Buffalo, N. Y.; secretary-treasurer, F. A. Preston, P. & M. Co., Chicago; executive committee, Walter H. Allen, Pennsylvania Steel Co., Steelton, Pa.; Thomas E. Vaughn, Vaughn Rail Support Co., St. Louis, Mo.

SQUARE OR BROKEN JOINTS ON TANGENTS.

The practice of the C. & N. W. Ry. is to lay rail with even joints on tangents and broken joints on curves. When starting in on a curve, a rail is cut in two pieces of such a length that if one piece is put in the track at the point of curve, the other piece when used at the other end of the curve will make the joints again square. The lengths of the cut pieces are different because the inside of a curve is shorter than the outside. The length to cut these rails is furnished by the engineer in charge.

Personally, I am in favor of broken joints both on curves and tangents unless it be on mud ballast, where, of course, the lateral motion would be more liable to cause the wheels to climb the rail. However, with anything like fair ballast, broken joints make a better track as you do not get such a hard blow as when joints are even and for this reason, good surface is easier to maintain. Also the track is easier to keep in line. I am not in favor of curving rail before laying unless the curve is an 8 degree or more unless curving can be done when the rail is being rolled or by some better means than any curver furnished to track men. Some rails are softer than others and you can not set your curver for any two rails alike. If you get too much curve in a rail it is worse than none and will cause the joints to stick in, and the track never can be kept to line.

Roadmaster, C. & N. W. Ry.

SCREW SPIKES.

Editor Engineering:

With reference to screw spikes I would advise that the D. & R. G. has had no experience with them.

One of the most important elements in their favor is that with their use it is possible to bore the spike holes before the preservative treatment is applied to the tie, thus avoiding the objection of perforating the outside shell of the tie with spike holes as in the application of drive spikes. To be sure, the holding power of the screw spike is many fold greater than that of the ordinary driven spike, but on the other hand there seems to me to be a possible objection to the screw spike in that the wave motion of the rail will lift the ties out of the ballast, a condition hardly possible with the drive spikes, because of the fact that the driven spikes are slightly elevated by this very wave motion.

I have inquired of railway men who are now using the screw spike as to just what effect this feature of the case will have on the track. In answer to these inquiries, I have been informed that as yet the screw spikes are in such an experimental stage that it will be sometime before this fact can be determined.

On our lines we use no treated ties, and therefore, the element in favor of the screw spike in this respect does not appeal to us as strongly as to other railroad companies.

It would seem advisable beyond a question of a doubt to limit their use to sections of track where there is no possibility of heaving in cold weather.

As regards the use of wooden plugs or dowels in connection with screw spikes, there occurs to me some doubt as to whether the additional efficiency of the appliance is commensurate with the extra cost.

I feel that in this whole matter I am not competent to pass an opinion of value, because as I stated above, of our lack of experience with the use of the screw spike, but it seems to me that its adoption and consequential discard of the drive spike is a matter for careful consideration, for from the information available at this date, there is some shadow of doubt in my mind as to whether the increased cost is justifiable for the additional service rendered. (Signed) J. G. GWYN,
Chief Engr., D. & R. G.

Editor Engineering:

We are not as yet an advocate of screw spikes under all conditions. At the same time, we have a few miles of experimental screw spikes and are watching their action, but without any very decided results. We certainly would not want to use them on dirt ballasted track, for in our opinion a piece of track that cannot afford ballast has got no business with screw spikes. In regard to the liability of track to heave, due to the action of frost, beg to advise that nearly 90 per cent of our mileage lies in a territory where frost does not enter the ground to an appreciable extent, and where frost is very prevalent we are on rock ballast, or else in so arid a region that gravel ballast practically prevents any trouble on that score.

(Signed) J. Q. BARLOW, Asst. Chief Engr.
Southern Pacific.

Editor Engineering:

With regard to screw spikes, I beg to say that I have never used them.

From following the subject, however, I would say that at the first opportunity, it is my intention to give screw spikes a full tryout. I do not believe that they would be advisable with the poorer grades of ballast as the liability to heave in cold weather would necessitate a considerable amount of shimming.

In my opinion, if screw spikes are used, the first installation could with advantage be made without wooden tie plugs, but if for any reason the screw spikes had to be withdrawn several times, it would then be necessary to put in the wooden tie plugs.

It is obvious that in order to make the adoption of screw spikes economical, we must resort to the use of machines for boring holes and putting in and withdrawing the screw spikes. This, I believe, is the principal reason why the adoption of the screw spike is moving so slowly, as the adoption of machinery means the handling of motor cars of some kind on the track, and railroads with dense traffic already find motor cars of any description on the track very objectionable. The sentiments of the operating department will be very difficult to overcome. (Signed) F. B. FREEMAN, Chief Engr.,
Boston & Albany.

Editor Engineering:

I favor the use of screw spikes when creosoted ties are used, because their use does not damage the tie and they make a much safer fastener, while the maintenance cost of keeping the screw spikes in place is practically nominal. I do not think it advisable to use the screw spike anywhere but on the best track.

Wooden tie plug is very essential where a screw spike is used in creosoted ties in order that the tie may be bored previous to creosoting.

(Signed) A. O. CUNNINGHAM, Chief Engr.,
Wabash R. R.

Editor Engineering:

With reference to screw spikes, I would like to see them tried. I have not had any experience with them, although I am somewhat prepossessed in their favor. It seems to me there should not be the same necessity for the use of shims as with the ordinary spikes, but it is not safe to say what will or what will not be in a new thing, until it is tried. We use wooden tie plugs to fill up old spike holes, and I think the practice is a good one. (Signed) S. B. FISHER, Chief Engr.,
M. K. & T. Ry.

MANGANESE FROGS.

Manganese steel frogs have come to stay. Their greater durability because of a hard wearing surface, and also their compactness, make them the most economical frog to buy. The time is rapidly approaching when no railway manager can afford to buy the low-priced built-up frog or crossing for a high speed, heavy traffic road, because they are proving to be too expensive. The constantly increasing weight of loads and rolling stock, with higher train speeds made possible by interlocked terminals at junction points and automatic block signals, make a boltless or rivetless frog or crossing almost a necessity.

The present prices of manganese steel frogs give a liberal percentage of economy. A manganese steel insert or solid

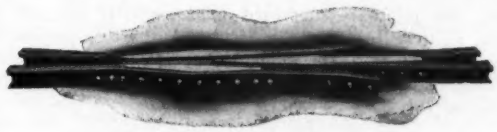
Weir Solid Manganese Frog.

frog costs from three to four times as much as a built up one and wears from six to eight times as long. Add to this the cost of renewing and maintaining a built-up frog and you have a still greater profit.

For a while railway engineers were very doubtful about the safety of putting a cast metal frog under their heavy high speed trains. They had to learn that manganese steel possessed properties different from any other steel casting heretofore made. Its hardness combined with its ductility are unusual. It is a metal which will produce castings that can be hardened and toughened by an inexpensive treatment. The result is a cast metal that will wear like hardened carbon steel but which does not have its brittleness.

Manganese steel is as ductile as soft steel and nearly as hard as tempered steel. This ductility is shown by the fact that when solid manganese steel crossing castings were first made, treated manganese steel castings containing shrinkage cracks were put in the track and the cracks did not extend nor spread as they would have done in a carbon steel casting, whose elastic limit is higher. Manganese steel stretches under conditions which make carbon steel break.

The United States Government which uses a large amount of cast manganese steel upon the dredges, steam shovels and railway track at the Panama Canal, has specifications for physical tests of this steel as follows: A cast and treated test bar ½" x 1" x 12" must be bent cold through an arc of 180° without showing a fracture at the bend. Any metal



Weir Insert Manganese Frog.

which will do this must have a low elastic limit, and that a very hard metal will do it is certainly an unusual and wonderful thing.

There are two types of frog made by the Weir Frog Co., Cincinnati, Ohio, in which manganese steel forms the wearing surface; one the insert frog and the other the solid frog. In the insert frog, manganese steel forms the wing rail bearings, point and heel riser in one integral casting. Rolled carbon rail is fastened to this casting at the heel and toe of the frog. This type of frog may be made any length desired. The bolts keep tight in this frog under conditions which will loosen them in a built up bessemer steel frog, because the weight of the wheels is carried by the casting and there is less strain upon the bolts to stretch them, and to let the parts of the frog hammer. There are but two objections to an insert frog: First, the rails may in time jar loose; second, there is not a full wheel tread bearing of manganese through the frog and the rolled rails wear faster than the manganese castings. They are, however, a great improvement over the old built up rail frog with its separate filling blocks and point rails. The above company uses a method of securing the castings to the rails which it claims keeps the parts tight longer than any other design of insert frog.

The solid managanese frog is a one piece proposition, made with point, wing rail, heel block and foot guards in one casting without bolts, filler blocks or rails. Compared with a built up rail frog containing 100 separate pieces there can be no argument about its superiority. The Weir solid manganese frog has easer extensions at heel and toe bridging the joint between the abutting rails and the frog casting. This design permits long track rails to be placed up to the frog without cutting the flanges of the rails. The holes in the cast frog match the spacing of the standard angle bars of the railway. There is a maximum wheel tread upon solid manganese steel the entire length of the frog—all that the wheel can use.

This design has a maximum tread bearing with a minimum of length and weight and therefore its cost is a minimum. The design was made in January, 1907, but no frogs were made until a year later because the price was so much higher than railway managers were accustomed to pay for built up frogs. This design permits frogs to be made with the least possible length and therefore makes frogs having the minimum amount of manganese steel for a given angle and rail. They cost less than solid frogs which have rail shaped arms at each end and it is claimed, are less apt to fail in service. The easer extensions are ground to fit the rail section and the top of the frog casting is ground to surface and line.

It seems hard to imagine how this frog can be improved; the design affords easy riding joints and maximum wheel tread bearing; the metal fulfills the ideal requirement of hardness and toughness.

CHEHALIS RIVER BRIDGE, O.-W. R. R. & N.

The big steel bridge being constructed by the O.-W. R. R. & N. across the Chehalis River at Aberdeen, is practically completed. This bridge is made up of two 160′ through pin spans, one 180′ through pin span and one 335′ draw span. These are built in accordance with the common standard plans of the Harriman System, being proportioned for E 55 loading. They are provided with sidewalks to take care of foot traffic over the Chehalis River between Aberdeen and its suburb South Aberdeen. The swing span is provided with a 25 h. p., d. c. electric motor and with a 50 h. p. Fairbanks Morse gasoline engine as an auxiliary, together with a hand operating outfit. It is a pivot bearing span. The piers are concrete, supported on piles and extend about 20′ into the river bed, which depth is considered ample to take care of scour and the requirements of future dredging. There are about 6,500 cubic yards of concrete in the piers. The concrete was made in a 1:2:4 mixture where deposited under water, and a 1:3:6 mixture where built in the dry. Sufficient concrete was placed in the piers under water to take care of chances of the crib floating and other contingencies that occur in such work. Owing to the large number of log rafts passing the site of the bridge, construction was rendered rather hazardous at times, since the bridge is also in a position exposed to heavy winds.

Gravel as Ballast

In connection with its work for 1910, Committee I—Roadway, Railway Engineering Association, had a sub-committee at work on the question of "Unit Pressure on Roadbed," and Committee II—Ballast, had a sub committee on the correlated question of "Necessary Depth of Ballast," and at a joint meeting of these sub-committees a paper on "Gravel as Ballast," by C. Brauning, which Mr. W. M. Dawley had translated from "Zeitschrift fur Bauwesen," Vol. LIV., Berlin, 1904, was discussed, and accepted as valuable information for the members of the association.

We give herewith the conclusions reached in the series of tests described in the paper: The traffic over the roadbed tested, yearly amounted to about 1.2 million tons. Among the daily trains which covered these stretches were several which had a velocity of 75 kilometers per hour and more. The observations were continued two years, the elevation of the rails was taken every two months, and during affecting weather conditions more often.

The principal requirements for a permanent and uniform roadbed with gravel ballast may be summed up as follows:

The sub-soil upon which the roadbed rests should consist, to a depth of the frost line, of a material which is not affected by weather conditions, nor, when frozen, heaves upward, thus disturbing the ballast.

The continued settling of the rail bears a distinct relation to the internal resistances of the ballast. Hence, ballast, as far as it is subjected to such forces, should consist of material which is uniform in its carrying capacity. When the carrying capacity of the sub-soil, therefore, is not high or varies greatly, as is the case with all earthy soils, the roadbed should be of such strength that the individual loads on the ties are evenly distributed throughout the ballast and uniformly distributed over the sub-soil. Furthermore, all sidewise and circulating movements should be confined within the ballast.

In order to meet these requirements, a depth of bed of about 22 in. underneath the ties would be sufficient, provided some particularly unfavorable conditions of the sub-soil did not make a greater depth necessary. A clean sand, readily permitting water to pass through it, would act well at the bottom of this bed. The actual depth of the ballast should not exceed 12 in. underneath the ties in order to prevent mixing with the bottom layer of sand. Regarding the size of the gravel grains, it is desirable, in order to secure a ballast which drains readily in its upper layers, and in order to prevent the undue formation of dust underneath and following trains and in consideration of the future increase of fine grain content due to tamping, to prevent as much as possible the admission of fine grained particles in the ballast. This, however, only means particles less than about ⅛ in. in size. As a matter of fact, a mixture of fine and coarse grains is desirable, since it permits of a more solid packing of the gravel underneath the ties than when only coarse gravel is used. But, due to the moist condition of gravel, it is not very convenient to segregate the fine particles from the coarser. In order to accomplish this separation, large coarse screens must be used. This results in a loss of a large and useful portion of the gravel, and the part remaining is often so little that the advantage gained by sifting is not warranted, due to the great expense involved. Under these conditions, therefore, gravel with a 25 per cent. content of grains 1-16 in. or less in size becomes practicable, as long as the conditions are not extraordinary and require an especially strong roadbed.

The width of roadbed bears a certain relation to the length of ties and the spacing of the ties. It is considered that an extension of the ballast outwards from the ends of the tie, with their usual length of about 9 ft., amounting to 12 ins., is sufficient.

As the height to which the ballast is packed increases, the carrying capacity of the roadbed increases. Hence, material should be piled between the ties as high as operating conditions will permit.

The width of the tie is also of considerable importance, since with constant load the unit pressures on the bed are reduced as the area of the tie increases, and the carrying capacity of the tie increases directly as its area. A general use of larger wood ties is not permissible, owing to the high purchase price and the greater difficulty of obtaining the same. It is desirable to have the ties 9 ft. 3 ins. in length. Strict consideration should always be given the proper and uniform spacing of ties and shaping of the roadbed in order to utilize to the limit the resistance of the roadbed.

Of greater importance than the width of the ties is the spacing of the ties. As the spacing is decreased two advantages are derived: first, the unit pressure decreases; second, the carrying capacity of the roadbed is increased. The limiting feature of decreasing tie-spacing is the ability to tamp the ties properly. Ties 6½ ins. in height can still be tamped with convenience when separated 14 ins. This is the one most effective and simplest means of increasing the strength of the roadbed, and to utilize it to the fullest advantage, especially on roadbeds which are fully loaded, is urgently recommended.

The portion of the ballast under the joints requires special consideration, since the impact at these points makes extraordinary demands on the roadbed. It has been attempted several times to strengthen this part of the ballast by packing crushed stone underneath the ties supporting the joint, however, without success.

Another way, and the one usually resorted to in order to accomplish the above, is to bring the two ties supporting the joint as close together as possible or about 20 ins. from center to center. The closer the ties are spaced outside of this particular territory supporting the joints, the less the difference is between the carrying capacity of the roadbed underneath the joints and the carrying capacity of the rest of the bed. In order to further strengthen the roadbed underneath a joint, it would be effective to increase the width of the ties supporting the joint. For instance, if the width of the ties used is 12 ins., and the distance between them from edge to edge is 10 ins., then the relation between them is 22—12=1.83, as compared with a relation of 24—10 2-5=2.31 for the ties not underneath the joints. By means of this decrease in the distance between the ties at the joints, combined with the increased width, as well as the distribution of the load over greater surfaces, the carrying capacity of the roadbed underneath the joints is increased approximately 75 per cent. Since, as ties are ordinarily furnished, there is considerable variation in sizes, there should be no difficulty in selecting a sufficient number of the proper width, to arrange underneath the joints for the above purpose.

As a further means of distributing the shock at the rail joints, methods of combining the two ties underneath each joint by the use of a framework are being tried out.

All means to increase the resistance of the ballast to impact will not be complete and sufficient to properly maintain the necessary support and steadiness of the whole roadbed as long as impacts, due to the passing traffic, at the rail joints continue to vary on account of the varying distance between rail ends, variation in the surface elevation of two abutting rails, wear of the rails and wheel flanges, and other changes in shapes which result in varying shocks. Hence, the question of a proper support for the rail joints is primarily a question of the proper joining of rails with the object of preventing low and loose joints.

HOW TO REMEDY SOFT SPOTS IN THE ROADBED.

Before suggesting a remedy for the cure of soft spots in a roadbed, we think it would be well to determine the cause of the troublesome places, as we think it would be far more economical to avoid them in the first place, than to spend the greater part of the allowance for maintenance trying to keep the track at such places in surface, line and gauge and ultimately, go to the expense of tile and cross draining which is the only effective method after the pockets have reached a depth where it is impossible to drain them by ordinary surface ditches.

Soft spots in roadbeds, on fills, are caused usually by objectionable material (usually clay from the bottom of barrow pits, or stumps or other timbers which are placed in the dumps by the contractor in order to complete the job as quickly and cheaply as possible). Decomposing timber and the gumbo clay of which the sub-grade is constructed, fail to support the track under heavy traffic and the weak places are shortly replenished with ballast of some kind and a typical soft spot is formed. Where these spots are caused by stumps or timbers placed in the dump, they should be removed or you may expect to have trouble until they have rotted entirely away.

When the sub-grade is constructed of clay of various natures, the worst perhaps is gumbo. Where rainfall is great, this clay gives little chance for water to run off, and it generally stands in pockets in the dump which changes from one side of track to the other and causing the clay to have upward and bulge out on sub-grade at base of ballast. To overcome this, trenches should be dug as shown in Fig. 1, beginning at opposite side of track and digging through the bulge to base of dump. These trenches should be dug a foot or eighteen inches below the bottom of the pocket and as far apart as the formation of the sub-grade requires. They should be eighteen inches wide to allow free working of men. Fill in bottom with coarse engine cinders to a height of 15 in., balance of trench with ordinary cinders, using care to keep the outlet free at all times.

DEPTH OF DITCH	MATERIAL		LABOR		
	TILE	CINDER	MAX.	MIN.	AVE.
3	.04	.04	.18	.10	.14
4	.04	.05	.37	.15	.20
5	.04	.06	.56	.21	.26
6	.04	.07	.75	.27	.33
7	.04	.09	1.00	.35	.42

COST PER DRAIN.

Fig. 1.

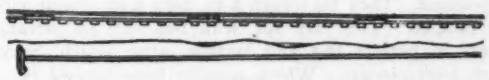
In cuts, soft spots are formed by pockets of plastic clay or depressions in the sub-grade which on account of insufficient drainage become thoroughly saturated during wet weather. This forms poor support for the ballast and allows the track to settle and forces the ballast below the sub-grade. Ballast of some kind is ordered and in the mean time mud shims, or often crossing plank or ties are placed under the track ties to maintain the surface temporarily. Very often the timber is left there when the ballast is finally received and applied. The renewal of the ballast is repeated at intervals until it is from 18 in. to 5 ft. deep. The clay that has been displaced by the ballast is forced outward and upward just outside the ballast line which intercepts the passage of water from the pocket to the open ditch, making it a difficult matter to drain it properly.

Many methods have been tried, with varying success, to remedy these soft spots and we will take them in order, as their location and the amount of money available, must determine very often, the method to be employed. Before considering the more expensive methods of draining roadbed we will take up the question of surface drainage.

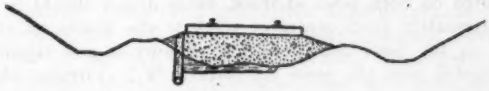
Where the conditions require it, a surface ditch should be constructed and maintained on the top of all cuts to care for the water running toward the cut from adjoining fields and an open ditch on each side of the track in cuts should be constructed, deep enough to carry the water it is expected to care for. Open ditches should be kept clean and free from obstructions so that no water will stand in them. Where standing water cannot be taken care of in this way, the ditches should be tile drained.

COST PER FOOT

DEPTH OF DRAIN	YARDS OF MATERIAL	MATERIAL CINDERS	LABOR AVE.
3	2.5	.55	1.10
4	3.4	.76	1.49
5	4.4	.98	1.93
6	5.4	1.21	2.50
7	6.6	1.47	3.20



PROFILE.



SECTION.

Fig. 2.

Where good surface drainage has failed, on account of the bottom of the pocket at a soft place becoming lower than the bottom of the adjoining ditch, making it impossible to drain it, the ballast may be removed, together with the clay shoulder which has heaved at either side and the cavity filled with good top soil from the adjoining right of way, practically forming a new sub-grade. This will remove the pocket which causes the trouble and will be found very satisfactory.

Where authority for tile draining ditches and roadbed may be had, it will be found to give the best results, however, and it is only a question of the best kind of tile to be used and the best and most economical method to be employed in order to get the best and most lasting results. Fig. 2 shows a method of tile and cross draining the roadbed which has been found satisfactory.

Beginning at the outlet, dig a trench eighteen inches wide, parallel with track so that tile when laid will be 9 in. out from end of ties and not less than 18 in. below the

*Committee report of the Roadmaster and Maintenance of Way Association.

pockets to be drained, being careful not to get less than 12 in. fall in 1,000 ft. Lay either 4-in. or 6-in. porous tiling without the bell joints, the entire length of cut carrying the water from the apex both ways or all one way as the conditions may require. Before laying the tile, use a round pointed tool to shape the bottom of the trench so the tile will lie in a round surface instead of on flat ground. This will have a tendency to keep the tile in perfect alignment and surface. When tile is laid, fill trench with engine cinders. Cross trenches should be dug as the conditions require it and filled with engine cinders as shown in Fig. 2.

The cost of this work varies greatly, being governed by local conditions and the kind of labor employed. The costs given in Fig. 1, however, were taken from a job recently completed and are authentic.

Fig. 3 shows a method of tiling and cross draining which has been found very satisfactory. The depth of the tile drain should be governed entirely by local conditions but should be below the frost line. The grade line should be determined by a competent engineer in order to insure satisfactory results. Use vitrified tile with bell ends not less than 6 in. in diameter. A line may be laid on one or both sides of cut as may be deemed necessary. The trench

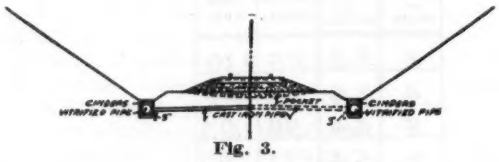


Fig. 3.

should be excavated 3 in. below the grade line and dirt should be trucked out of cut and placed on fill for widening the roadbed. Then fill trench 3 in. deep with engine cinders well tamped. Then lay tile with bell end up stream on cinders in perfect line and surface, after which, back fill trench with cinders. Where pockets have formed in roadbed, cross drains should be put in. Where a drain is constructed on both sides of track, cross drains should be put in alternately from center of track to the drains on either side as the local conditions may require it and should be connected with the main tile with a "T." Vitrified tile or short lengths of cast iron pipe are best for cross draining. Care should be used in establishing a grade line and the tile laid deep enough so that cross drains may be put in any time below any deformation or pocket in the roadbed.

Fig. 4 shows a plan for draining a cut which is expected to be double tracked later. This system consists of a single line of pipe on one side, laid as shown in Fig. 3 with cast iron cross drains at intervals to a catch basin on the opposite side to take care of surface water. When second track is laid the ditch should be partly filled with cinders

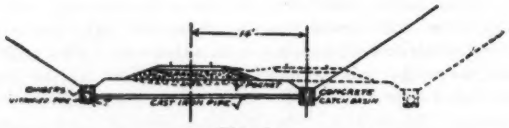


Fig. 4.

which will insure good drainage for the second track and an additional line of pipe should be laid outside of the new track.

To get good results, these tile ditches should be cleaned as often as it is necessary, and that is determined by weather conditions and the nature of the cut in which they are placed. Concrete catch basins, placed at intervals as conditions require to care for the surface water more quickly, will be found very satisfactory in times of heavy rainfall. There is a great difference of opinion as to the kind of tile which is best for this work. We would say to use the kind of tile best suited for the soil and local conditions which will be encountered at the point to be drained. The cost of construction for labor varies so greatly, being governed by the kind of labor employed and the conditions under which the work is to be done, that figures will be of little value as the cost runs from ten to thirty cents per foot, but at the maximum figure the benefits derived are so great that it warrants the expenditure.

TREATMENT OF CONCRETE SURFACES.

The plans and modes of surface exterior treatment to large massive work such as bridges, abutments, reservoirs, etc., or to exterior factory structures depend on either mechanical or chemical means. Mechanical treatment is executed either by skilled, or unskilled labor, or mechanical devices, in the following manner: Picked, scraped rubbed when green, bush hammered, tooled, sand blasted, etc. All of the treatments are more or less expensive; in many cases the workmen have shunned the corners, and the surface generally retains dust, dirt, and atmospheric gases which tend to cause disintegration and destruction in time. Mechanical treatments are generally for effect only, and give no great weather resistance to the surface. In fact they are unfavorable to many kinds of construction and in some cases only a make-shift to betterment.

Chemical treatment is also an unskilled or skilled labor treatment with commercial muriatic acid, acetic acid, etc., diluted in water. This method depends on cutting the scum surface to relieve the hidden aggregates. It is also a more or less expensive operation and the non-uniformity of the surface combined with its chemical action does not put it into special favor although such processes have been patented. The muriatic acid is liable to stain the surface and leave salts that will form a soluble alkali in combination with concrete and produce an efflorescence on the surface.

The veneer treatment to outside walls, with plaster, has proven quite unsatisfactory for many reasons. The bond to the concrete is likely to be weakened by the percolation of water through the plaster to the concrete surface, resulting in a loss of adhesion, strength and permeability. The outward influences, such as the sun's rays, frost, and rapid wetting and drying cause shrinkage of the veneer surface. These destructive agents are liable to destroy adhesion and cause cracking and scaling. Thus it would appear as if no plaster should be applied to exterior walls where moisture is liable to collect.

Coated surfaces are those, generally speaking, that have had cement grouts or washes applied to them. The latter are never stable and are used to fill up the unevenness of the surface without regard to their lasting qualities. In fact they are dangerous surfaces to apply any surfacing materials to because of the unstableness of the bond. Floor surfaces are tricky because no man finishes the entire area and a rigid inspection should be made before applying any treatment.

Deleterious external influences on concrete surfaces, such as heat, cold, sunshine, water pressure, and percolation, show their effects in two forms of disintegration—mechanical and chemical.

Mechanical action consists of a consequent washing away of the softer constituents from the surface on account of the action of water; cracking caused by the expanding action of frost; periodical expansion of the outer surface caused by the alternating action of the sun's rays.

Chemical action is caused by the proportion of carbonic acid gas, oxygen, water and gaseous products of combustion in the atmosphere which cause a separation of

scales, either thin or thick; these by accumulation and an infiltration of strange matter into the pores cause a peeling from the surface. In other words you get a condition of disintegration or corrosion both from within and without, which has been termed "wall rot proper."

The lodging of the soluble salts upon the surface is efflorescence and mainly due to conditions as above mentioned although local conditions and materials govern its area of trouble.

Materials for surface coating on concrete have been widely discussed pro and con by scientific bodies. Plaster has been found to be unreliable for exterior surface. Grouts are unstable.

To obtain an alkali and acid-proof vehicle with a pigment that will have sufficient wearing body has been the aim of the engineer, contractor, consumer and manufacturer. Below are a few of the essential factors: (1). Materials should contain vehicles and pigment working in harmony with the conditions upon the surface. (2). They should contain an acid and alkalai sun-proof color and pigment. (3). They should be sufficiently heavy to fill the surface voids and stop suction. (4). They should have a sufficiently hard wearing surface to allow successive coats without further treatment of the surface. (5). They should produce a finish sufficiently close to the texture and originality of the surface.

Treatments of concrete surfaces are separated into two divisions. The shallow or superficial method of treatment is a filling of the voids near the surface without discoloration. It is one that was much sought after in the early stages of concrete work, especially on concrete blocks, etc. Although the monolithic type of construction has gained more favor in larger construction, the mechanical treatments are still desired for some structures in need of shallow or superficial treatment. Cement bricks, blocks, and cast stone are surfaces that need a light treatment.

The physical or external method of treatment is a coating of natural materials as a prevention of contact between the elements and the construction. The treatment should be defined as follows: (1). Damp-proofing and decorative, without complete obliteration of the texture of the surface. (2). Water-proofing only, without the decorative feature and with a complete obliteration of the texture of the surface.

Under the first division you have a combination of preventatives against the external mechanical and chemical disintegration of surfaces. The operation should be twofold in its purpose, damp-proofing and decorative in one operation, without destroying the texture of the surface.

Under the second division comes the subject of waterproofing, (defined by Webster as proof against penetration) which may mean everything or anything—and we are sure the word has been handled improperly as to its meaning. It may only mean damp-proofing and not water-proofing. Water-proofing is an engineering problem and does not enter into the subject of concrete surface treatment.

The following essentials should be strictly adhered to to insure results in the surfacing of concrete: All exterior or interior surfaces must be free from loose scales, sand, grit. grease, oil or other foreign matter. Surfaces can be freed of such materials by either scraping, wire-brushing, or scrubbing with carborundum brick. No muriatic acid or other acid treatment should be used, unless the surface is thoroughly neutralized by water or a light alkaline solution. Green surfaces should be treated with a thin coat of surfacing materials to aid the neutralization of the free lime and fill the voids upon the surface.

After the first coat is applied, evaporated patches should be re-coated to insure evenness on future coats. All surfaces should be dry and free from moisture to give perfect adhesion. Exterior surfaces of buildings should be protected from rain or heat while drying.

The cost of physical or external treatment on two-coat work, including the cleaning and preparing the surface under ordinary conditions, is generally estimated at 25c to 40c a square yard.

The cost of covering a concrete surface is abort one-half that of lead and oil on wood—first coat—two-thirds that of lead and oil on wood—second cost—and equal to lead and oil on wood on the third coat for exterior surface. The labor for the physical coat treatment is about one-third greater than the application of lead and oil on wood for exterior surfaces.

The non-uniformity of surfaces, filling of voids and suction explains the need for several covering coats. On concrete floors the covering runs from 200 sq. ft. per gallon—first coat—to 400 sq. ft.—second coat—according to condition of surface. No one job is an example or guide—they all differ in uniformity of conditions. The shallow or superficial method or treatment for two coats costs about 1-3 to 1-2 per square yard less than the external treatments depending upon conditions.

The operator must be careful of the first or priming coat as this is the foundation for a perfect bond and neutralization of the surface for successive coats. The operator should produce a surface texture without destroying the originality of the surface.

No surface is free from dirt and foreign matter and it is necessary to remove such substances either by wire brushing or a light acid treatment, the latter to remove stains, in order to secure a firm bond and penetrating quality.

Concrete construction is being adopted very extensively by the railroads and in adopting this material as a form of building and maintenance of way construction many questions arise as to the results which will be obtained under the innumerable uses to which concrete is being put. The question of concrete construction has had the most careful consideration of the Glidden Varnish Co., of Cleveland, Ohio, and exhaustive experiments and research work has been conducted by this company covering a period of the past five years and they have developed some excellent materials for the protection, decoration, dampproofing and water-proofing of concrete. These products cover a very wide field of use and their technical department will be pleased to give all information and render all possible assistance to concrete engineers in regard to the best specification and method of treatment of any concrete surface.

Personals

J. H. Nuelle, assistant engineer of the New York, Ontario & Western, Norwich, N. Y., has received an appointment as principal assistant engineer, with office at Middletown, N. Y., and the former office has been abolished. Mr. Nuelle succeeds J. C. Bentley, resigned. F. J. Mayer succeeds A. Van Aken as supervisor, with office at Kingston. R. F. Gies, bridge inspector, has been appointed bridge and building inspector.

R. B. Burke has been appointed chief engineer of construction of the Chesapeake & Ohio, with office at Richmond, Va., succeeding Henry Pierce, deceased.

F. G. Jonah, chief engineer of construction, St. Louis & San Francisco, at St. Louis, Mo., has also been appointed consulting engineer of the Brownwood North & South. Thomas Yates has been appointed chief engineer of the latter road, with office at Brownwood, Tex.

T. L. Dunn, chief engineer of the Maine Central, has been also appointed chief engineer of the Sandy River & Rangely Lakes. The office is at Portland, Me.

C. J. McCarthy, chief carpenter of the northern district, Chicago, Milwaukee & St. Paul, at Minneapolis, Minn., has been transferred to Aberdeen, succeeding E. Collins, resigned to accept service elsewhere. W. H. McArthur succeeds C. J. McCarthy.

The office of principal assistant engineer of the Missouri, Kansas & Texas at Parsons, Tex., has been abolished and F. Ringer, who formerly held the position, has been appointed assistant chief engineer, with office at St. Louis. The office of resident engineer at Sedalia, Mo., has been abolished and R. M. Garrett, who held the position, has been made district engineer, office at Parsons.

J. M. R. Fairbairn, engineer maintenance of way of the Canadian Pacific at Montreal, Que., has been appointed assistant chief engineer of eastern lines, with office at Montreal.

M. A. Baird, supervisor of signals of the Erie, has been appointed general signal inspector. H. C. Price, foreman of interlocking, succeeds M. A. Baird as supervisor at Jersey City, N. J.

J. B. Ingersoll, who resigned as chief electrical engineer of the Spokane & Inland Empire, has been appointed electrical engineer of the British Columbia Electric, with office at Vancouver, B. C.

D. O. Connell has been appointed roadmaster of the Pecos & Northern Texas, with office at Plainview, Tex., succeeding William McCrate.

E. E. Backus has been appointed superintendent of telegraph of the El Paso & Southwestern, in charge of the operation and maintenance of telegraph and telephone lines and block signals. The office is at El Paso, Tex.

B. Herman has been appointed chief engineer maintenance of way of the Southern, and also the Virginia & Southwestern, with headquarters at 1300 Pennsylvania Ave., Washington, D. C.

D. N. Hooker has received an appointment as chief engineer of the Wichita Falls Route, with office at Wichita Falls, Tex., succeeding R. A. Thompson, resigned to accept the position of engineer with the California Railway Commission.

E. Collings, formerly chief carpenter of the Chicago, Milwaukee & St. Paul at Aberdeen, S. D., has been appointed chief carpenter of the Chicago, Milwaukee & Puget Sound, with headquarters at Malden, Wash.

B. C. Martin, resident engineer of the New York Central & Hudson River at Watertown, N. Y., has been transferred to Utica, with the same title.

With The Manufacturers

VAUGHN RAIL SUPPORT.

The idea that it is not desirable to have a direct fastening between a rail and tie is embodied in the combined tie plate and rail anchor, shown in accompanying photographs.

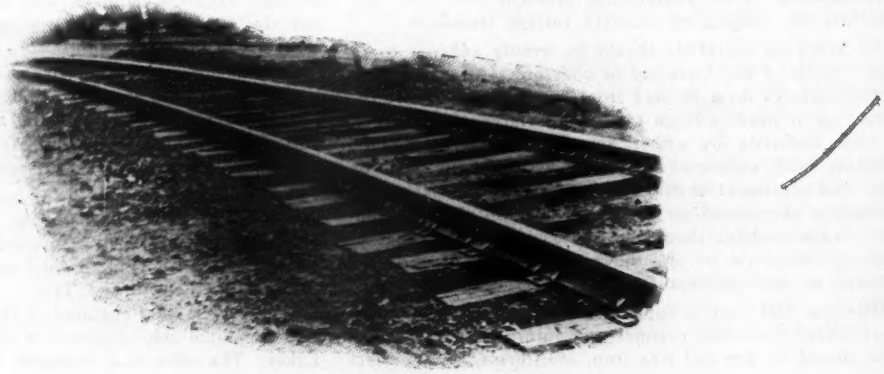
It is easily seen that an efficient device of this character completely eliminates the need for and expense of anti-creepers. A tie plate is a necessity with practically any soft wood, and is especially needed if the tie has been treated to prolong its life. A treated tie should be protected in such a way that mechanical forces will not destroy the tie until the full life has been realized, and thus the full benefit of the preservative treatment received.

To prevent track from creeping it is very desirable that an equal resisting force be exerted by each tie, or that as many ties as possible be securely locked to the rail. Where separate anti-creepers are used in insufficient quantities, joint ties and the ties against which the anti-creepers rest are dragged through the ballast, causing the early destruction of the tie, without remedying the trouble.

In general the fewer the number of parts of parts in any track device the easier it is to apply and maintain, and the less likelihood there is of the parts becoming lost before application, or later getting loose and rattling. The rail support herein described consists only of a plate and two (or possibly four) screw or drive spikes. The spikes fasten the plate to the tie, and the plate is fastened to the rail by bending the four lugs over the base of rail, using a spike maul.

The following claims for this rail support are based on a demonstration of over fifteen months on the Eads Bridge, under both passenger passenger and heavy freight traffic on the St. Louis Terminal R. R.: no creeping, spreading or kinks, and supports do not loosen on tie or rail; no deflection or mechanical injury to the tie; no expense in maintenance since supports were applied; eliminates the cost of tie plates; dispenses with rail braces, continuous joints, and anti-creepers; holds the rail absolutely in alignment either on tangents or curves; keeps track to exact gauge; preserves ties; permits the use of the less expensive class of timber; acts as an anti-creeper because it prevents wave motion of the track under traffic; avoids all possibilities of derailments due to rail breakage.

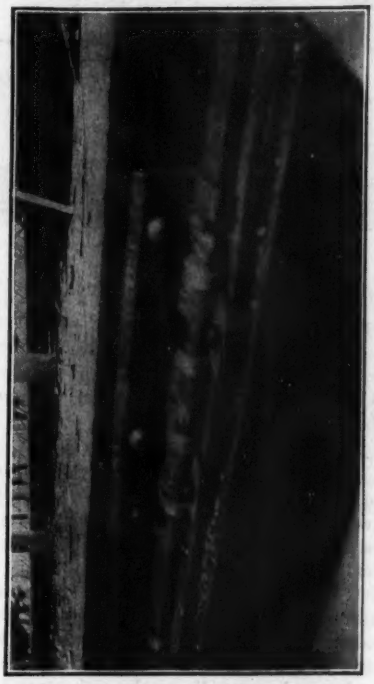
It does all these things, and at the same time costs no more than many tie plates now on the market and is just as easy to apply. A special sized rail support is made for use under guard rails, and has been giving good service on



Vaughn Rail Supports in Track.

some sharp curves on the above-mentioned railway. These rail supports are manufactured by the Vaughn Rail Support Co., of St. Louis, Mo.

Application of Vaughn Rail Support.



Vaughn Rail Support at Joint.

LIGHTING CONSTRUCTION WORK AT NIGHT.

A successful stationary lighting equipment for contractors has been on the market for the past year. It constitutes a practical outfit to light construction work of all characters at night. The equipment is particularly adapted for steam shovels, drag line excavators, dredges, wrecking cranes, and for heavy foundation work, tunneling, grading, etc.

The equipment consists of a small steam turbine engine with a direct connected dynamo, and an arc lamp with a special reflector in a portable weather-proof case. Electric current for the lamp is supplied by the dynamo, delivering about 35 amperes at about 35 volts. The very low voltage makes it impossible to get a shock from the equipment no matter how it is handled. This is an especially valuable feature on out-door work where many common laborers are employed. The working parts of the dynamo and engine are so simple that any hoisting engineer or man of similar experience can understand it at once.

The small steam turbine engine is practically automatic in operation. An automatic governor assures uniform speed even with sudden variations in steam pressure. This is a great advantage where steam is supplied from the boilers of steam shovels, dredges, hoisting engines and such equipment. The turbine engine is equipped with a centrifugal brake which is set to act at a speed slightly greater than the point at which the governor acts. The engine is built to eliminate bearing troubles.

The direct connected dynamo and turbine are self-contained on the same base and are each enclosed in a weather-proof case. The weight of the complete unit is 327 pounds. The unit is only thirty inches long, eighteen inches high and eighteen inches wide, so it can be set in a very small space in an out-of-way place.

The lamp and reflector for lighting construction work have been developed especially to meet the widely different conditions that occur on such work. The lamp and reflector in a tight weather-proof case weigh 92 pounds complete and can be set at any point on the job without reference to the engine and dynamo by simply running a cable from the dynamo to the lamp; thus the light can be moved whenever and wherever desired. Thousands of these lamps are operating successfully every night in the year. The reflector is of an entirely special design, built to diffuse and distribute the light over a wide area. A sliding base provided for the lamp also permits the position of the lamp to be changed with reference to the reflector. In this way an effect ranging from the complete diffusion of the light to the concentration of the rays in a smaller area can be secured in a moment. This feature makes it possible to use the same lighting equipment with equal success on work of greatly different character.

The lamp with a special reflector is about 250,000 candle power. When the reflector is set to diffuse the light the area in front of it within a radius of 150 feet is illuminated so that work can be handled with practically the same efficiency as in day-light.

The dynamo furnishes about 59 candle power in excess of the requirements of the large arc and this excess can be utilized in some incandescent lamps placed anywhere desired on the job. Provision thus is made for lighting directly under or out-of-the-way places around steam shovels, drag line excavators and similar machines. The small lamps also are ample for the firemen and engineers.

When the arc is not in use about 290 candle power is available for carbon filament incandescent lamps anywhere

on the job, or the equipment will run 50 twenty-watt Tungsten lamps, or 28 sixteen-candle power Tantalum lamps, or 32 eight-candle power Tantalum lamps, which can be placed anywhere desired on the job. The weather-proof case containing the lamp and reflector can be shifted from place to place on the job as the work progresses. The low voltage eliminates the need of special cable to connect the lamp and dynamo.

The outfit is shipped so it can be set up by anyone familiar with a construction plant. All that has to be done is to set the turbine-dynamo unit in a place convenient to a boiler and make a ¾-inch steam pipe connection from the boiler to the turbine engine. No permanent foundation is necessary.

The only attention required after the machine is running is to see that it is kept oiled and to trim the lamp when carbons are consumed. One carbon will burn between eight and nine hours.

The Pyle-National Electric Headlight Co. issues a booklet (sent on request) entitled "How to increase the efficiency of your night shift," which explains the above mentioned equipment and shows some views of different jobs taken at night with no other light than that furnished by one of their special stationary lighting equipments.

" 4 " 30 "	32	7,753	32	3,471
" 4 " 50 "	30	6,234	30	2,528
" 6 " 20 "	30	6,435	30	2,842
" 10 " 20 "	32	6,513	32	2,763
Steamed and creosoted	30	5,281	18	2,448
Steamed and treated with zinc chloride	26	5,838	20	2,657
Natural	26	7,747	16	3,598

For boring ties and applying screw spikes Spencer Otis & Co. have put the Au-Tra-Kar on the market. This gasoline car is used to transport laborers to and from work. After reaching the work the engine drive can be disconnected from the axles and connected to furnish power for boring holes in ties and applying screw spikes, for drilling rails, running emery wheels, etc. The engine furnishes sufficient power to propel two loaded push cars as well as a heavy load on the gasoline car.

When the transmission clutch is thrown out the car is brought to a stop, and by throwing in another clutch the power shafts, four in number, are started. Each power shaft can be run independent if wanted, this being accomplished by means of separate clutches connecting the engine to each shaft.

The Atchison, Topeka & Santa Fe has 60 of these cars in service, several of which are equipped with screw spike driving attachments.

The illustration shows one of these cars at work boring ties and driving screw spikes. As the illustration shows, the working attachments or tools are supported on small cranes, which relieve the operators of the weight of the tools and of the torsional thrust. These cranes also hold the tool vertical, thus insuring the proper boring of the hole and setting of the spike. The shafts supporting the tools are telescoping and permit an adjustment so that work can be done on three ties with each tool, without moving the car. The boring attachments are at the front, and the car is advanced as rapidly as the spikes are screwed down at the rear. The boring heads are equipped with reverse levers making it possible to drive or draw the spike at the will of the operator.

Au-Tra-Kar for Driving Screw Spikes.

AU-TRA-KAR FOR DRIVING SCREW SPIKES.

The use of screw spikes while far from being general in America, has been common practice in some European countries for a number of years. In the United States there seems to be a growing sentiment in favor of the screw spike for high-class stone-ballasted tracks.

The table herewith shows a comparison of the holding power of screw and drive spikes in Loblolly pine, showing a decidedly greater holding power for the screw spike, and the screw spike does not injure the fibers of the wood as the drive spikes do.

Effect of Cylinder Operations on the Holding Power of Loblolly Pine for Screw Spikes and Common Spikes.

SEASONED TIES.	SCREW SPIKE.		COMMON SPIKE.	
Treatment.	Number of tests.	Force required to pull spike, pounds.	Number of tests.	Force required to pull spike, pounds.
Steam 4 hrs. 10 lbs.	32	9,185	32	3,983

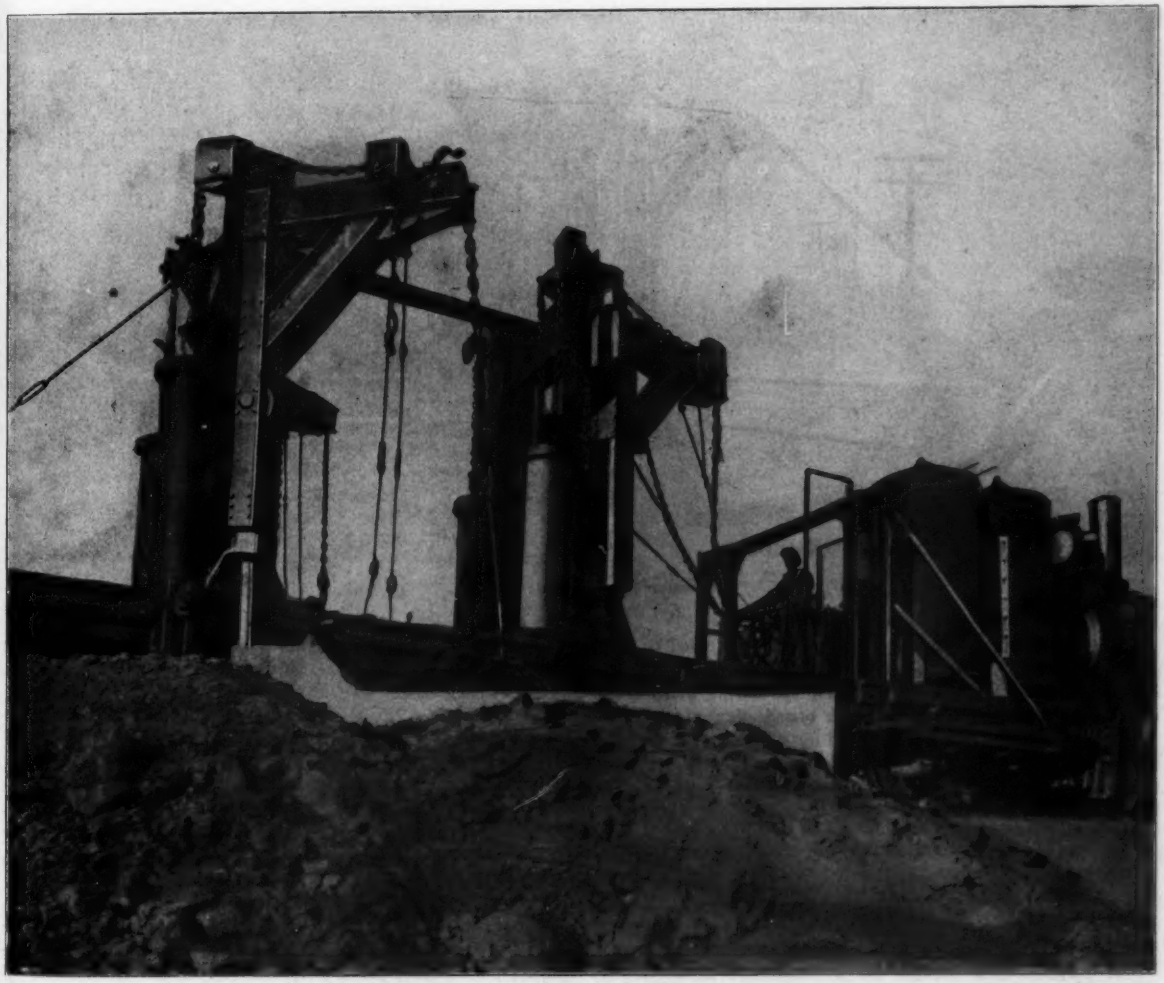
The car has a seating capacity for ten men, weighs 1,100 lbs. without attachments and 1,600 lbs. with attachments. The speed with the maximum load is 20 miles per hour, with a fuel consumption of about a gallon per 12 miles traveled. When inserting screw spikes the consumption is about 1 gal. per hour. The car is equipped with a force-feed mechanical lubricator. The carburetor is simplicity itself, having but one adjustment, thus getting away from the complications of the many adjustments of the ordinary carburetor used on cars of this kind. The housings for the driving and boring tools are made of aluminum.

In a recent test three men using two driving spindles drove the spikes for fourteen 33-ft. rails, 20 ties per rail, in three hours. The holes were bored in the ties before being placed under the track.

THE BOWMAN DITCHER.

The car body of the Bowman Ditcher is similar to the ordinary flat car. On it are mounted four pneumatic cranes which handle the ditching tools, consisting of plows, slopers and scoops. Two of the cranes are located on each side of the car and the operations can be carried on on both sides of the track at once. The operation of the machine consists in mounting a set of implements to the cranes and then dragging the car along with a locomotive.

The cranes raise and dump the scoops. There are two large air cylinders for operating the cranes, and two smaller cylinders for dumping the buckets. Compressors are located on the end of the ditcher; these air compressors are supplied by four No. 5 New York air pumps operated by steam supplied by the locomotive. All the operations are controlled by one man by means of 18 valves.



Bowman Ditcher Leveling Off Unloaded Material.

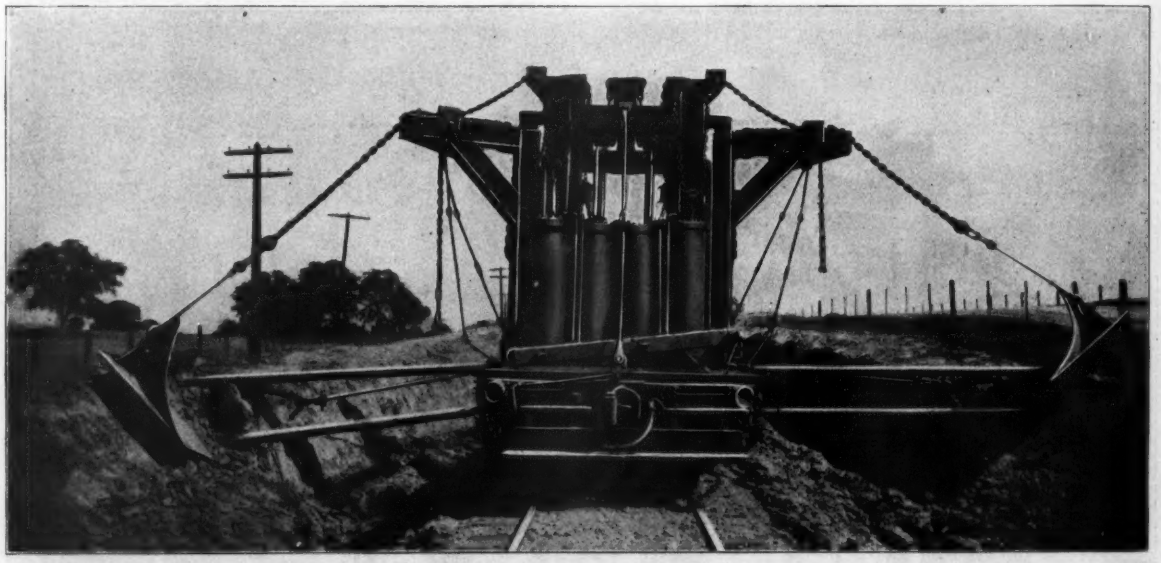
It has been demonstrated that the machine is capable of inserting spikes at the rate of 4 rail lengths, 88 ties, or a total of 352 spikes, per hour, and maintain this speed for the working day of 10 hours. This speed allows the workmen a margin of time for straightening ties and such other details as are necessary to complete the work.

The Au-Tra-Kar is sold by Spencer, Otis & Co., Railway Exchange Bldg., Chicago.

The plow is hung from the main chain of the rear crane, which controls its working depth. Its line of action is controlled by the guiding cylinder which acts through a steel pole attached at the rear of the plow. A second steel pole is attached to the plow beam, near its forward end, with a universal joint permitting horizontal or vertical movements of the plow. A pulling cable is attached to the front end of the plow and is fastened to the forward end of the car. The pole to the center of the plow holds it a uniform distance

from the car. This pole is made in two telescoping parts, and its length may be changed through a wide range of working distances. Bolts passing through corresponding holes in the sleeve and inner rod, maintain the pole at the desired length. A variation in range can also be accomplished by shortening the guiding chain which pulls the rod so that it is not perpendicular to the car. The plow used on this machine is a special design as it was found that the heaviest on the market was too light for the work.

The material loosened by the plows is collected by the scoops. There are two scoops, capacity 4 yards, on each side of the car, one for each crane. These are constructed and hung so that when filled and lifted they will tilt backwards and prevent any of the dirt from spilling. The scoops are hoisted by the main crane cylinders through a single chain attached to the bail.



Bowman Ditcher Widening Cut.

The same beam used to support the scoops is used to support the sloper. It consists of a flat steel plate about 4 ft. square to which is riveted a curved plate flaring away from it at the rear to imitate the mold board of a plow. The angle of ditch slope may be changed by shortening or lengthening two fulcrum poles fastened to the side of the car and to the sloper. The working position of the sloper is controlled by the main chain of the rear crane.

The spreader works at an angle of about 40° to the car, when in use. A bracing bar extending from the frame of the car maintains the spreader in this position. When not in use the pole is removed and the spreader is swung in against the side of the car. The function of the spreaders is to level back the material after it has been unloaded alongside a fill.

The first operation on using the ditcher is to break up the ground by means of the plows. The operator has absolute control of the plow, and can at will, raise, lower, tilt, or move it laterally. The scoops are swung out and filled by dragging through the loose material. They are then raised by the air hoists, the car is towed to the dumping ground, and the scoops emptied. The two lead buckets are lowered and filled first, and after being raised to clear, the rear buckets are lowered and filled. This process is repeated until the ditch is the desired depth. The sloper is then used to give the finish to the ditch. The spreader is used whenever necessary to keep the unloaded material back from the track.

The ditcher described above was tried out on the material of the California foot hills, on the Southern Pacific. The tests were conducted in midsummer when the material was baked nearly to the consistency of hardpan. Under these conditions the machine made a record of 360 cu. yds. in 6 hours, or 60 yards per hour. The scoops were loaded 30 times, the average haul being 1,200 ft. All operations of plowing, loading and unloading, and spreading were necessary in the above case. Average costs for 18 months have shown the following results: Average yards excavated per month 8,720; cost including miscellaneous work a little over 20c per yard; cost excluding miscellaneous work about 15c per yard.

The Eagle Foundry & Machine Co., Ft. Scott, Kan., has acquired the manufacturing rights for the Bowman Ditcher, for the United States, and are putting these machines out on a yardage rental base.

INDUSTRIAL NOTES

James A. Lister, formerly Chicago manager of the Pittsburgh Testing Laboratory, has severed his connection with the above concern and is now associated with the Hildreth-Jones Company in the capacity of manager of their bridge, structural steel, and cement departments.

Mr. E. O. Sessions, of the firm of Woodmansee, Davidson & Sessions, Consulting Engineers, Chicago, is in California on a professional business trip.

The Standard Scale & Supply Co., of Pittsburgh, Pa., recently made a shipment of ten carloads of scales and trucks for use at the new plant of Sulzberger & Sons Co., at Oklahoma City Oklahoma. This order, as well as the one for 35 scales mostly 120 ton railroad track scales, for the bureau of gas, water and electricity of Brooklyn, New York, also recently shipped, are the largest orders for this class of goods placed in recent years. In the equipment for Sulzberger & Sons Co., were included a large number of special new pattern portable suspension scales with steel plate platforms

which have recently been put on the market by the above company. This scale eliminates the necessity of cutting the floor where the scale is placed and it is only necessary to use an incline of two inches at each end to run on the platform. This type of scale is particularly desirable for users where the floors are damp and wet as there is no opening to allow the water to run through to the floor below. Because of its advantages this scale is being adopted by various packing houses and other users throughout the country.

The Electric Properties Co., New York, has moved its offices from 165 Broadway to 10 Bridge street, where Westinghouse, Church, Kerr & Company, of which it is the holding company, is now located.

The Fairbanks-Morse Co. has been awarded the contract for the installation of dynamos and other electrical equipment in the engineering building of the University of Louisville.

The Genuine Open Hearth Iron Metal Products Co. has been incorporated in Newport, Ky. A. L. Andrews, of the Newport Rolling Mills, is one of the incorporators.

Gano Dunn, for many years chief engineer and vice-president of the Crocker-Wheeler Company, Ampere, N. J., has resigned to go into other business.

W. G. Hovey, recently with the Hall Signal Company, New York, has taken a position in the railway sales department of the Okonite Company, New York. W. A. Peddle, signal engineer of the Hall company, in charge of estimating and construction, wtih office at Garwood, N. J., has been transferred to the sales department, with office in New York. H. L. Hollister, engineer for the western district, with office in Chicago, succeeds Mr. Peddle.

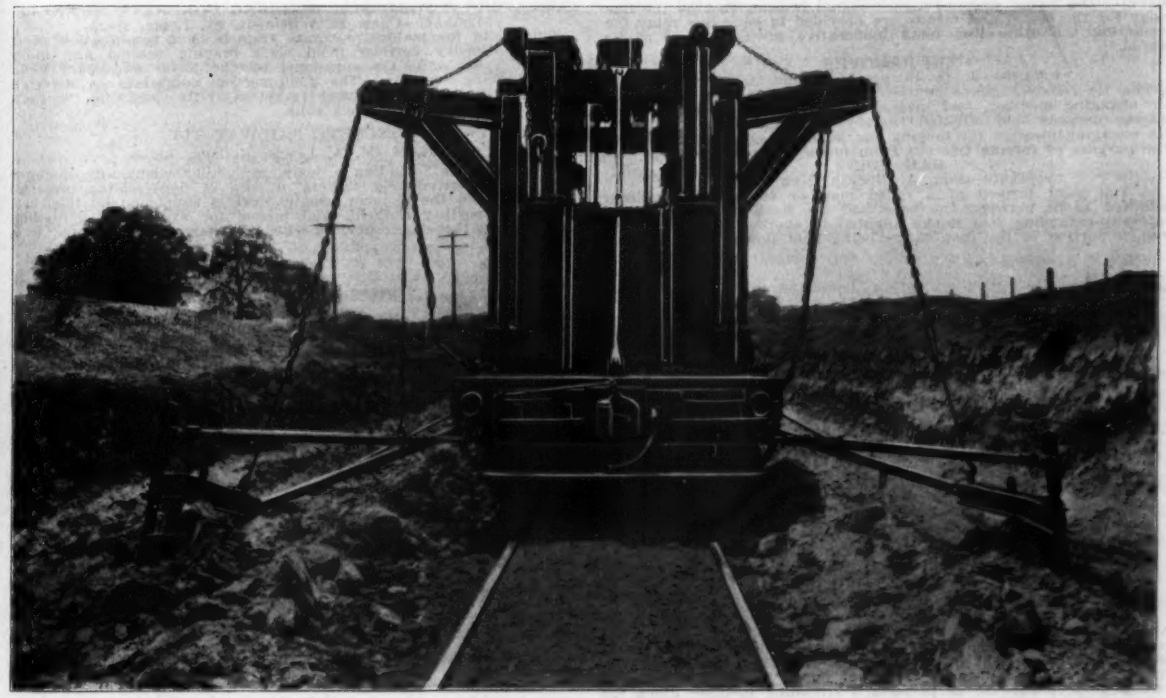
The Chicago Pneumatic Tool Co. has appointed Luther H. Bryan, formerly general foreman of locomotive repairs, on the Duluth & Iron Range R. R., and well known as secretary of the International Railway Foreman's association, as its representative at Birmingham, Ala.

The Isthmian Canal Commission is asking bids until November 20 on electric towing locomotives for all the canal locks. Sealed proposals in triplicate will be received at the office of the general purchasing officer of the Interstate Commerce Commission, Washington, D. C.

The Roberts & Schaefer Company, Chicago, has been awarded a contract by the Kentucky & Indiana Terminal, for designing and building a 500-ton fireproof Holmen counterbalanced bucket locomotive coaling station for installation at Louisville, Ky.

The Railway Sales Co., Chicago, has been organized to engage in the manufacture and sale of metal specialties. The incorporators are: Geo. S. Andres, Chas. W. Switson and Lawrence J. Walsh. Capital, $34,000.

E. C. McMillan, mechanical engineer of the American Bureau of Inspection & Tests, has been appointed manager of that concern, with office at Pittsburgh, succeeding George W. Greene, resigned.



Bowman Ditcher Plowing Up and Loosening Ground Preparatory to Loading.

The Southern Railway & Navigation Co. will construct a 750-ft. steel bridge on its extension southwest from Cooksville, La. D. J. Jeffris, general manager, Pullman building, Chicago, Ill.

The Chicago Great Western R. R., it is reported, will build a reinforced concrete coaling station at Sycamore, Ill., to cost about $25,000.

The Missouri Pacific has made an appropriation of $53,000 for improvements at Wichita, Kan., to include a concrete bridge at Twenty-third street and a new steel or concrete bridge over the Arkansas river.

The Minneapolis, St. Paul & Sault Ste. Marie has let the contract and started construction on a new passenger station at Antioch, Ill.

The Western Maryland has awarded a contract to the Carter Construction Co., for improvements to its Port Covington yards to cost $250,000.

Recent Engineering and Maintenance of Way Patents

CROSSING FROG.

1,002,964—C. C. Chambers, Chicago, Ill.

This railway frog is a combination of a base block having wheel flange grooves and a central recess formed in the upper side. A wear-plate is arranged in the recess having grooves in its upper side registering with the grooves in the base block; downwardly and outwardly projecting fingers are provided at the periphery of the wear-plate engaging slots in the adjacent portions of the block. Wedge members are adapted to be driven into the slots into engagement with the upper sides of the fingers for removably securing the plate in position in the recess.

RAILWAY SIGNALING SYSTEM.

1,003,199—T. H. Patenall and W. W. Talbert, assignors to the Union Switch & Signal Co., Swissville, Pa.

This railway signaling system consists of a block section, track circuits and a signal located adjacent each end of the block section for governing traffic into the block section from one end. A line relay is provided for each signal controlled by track circuits adjacent the end of the block section opposite to the signal. The signal circuit for each signal is controlled by the line relay for the signal and means are provided in each line relay for rendering the other line relay inoperative in its control of its signal.

TIE REMOVER.

1,003,399—J. C. Burns, Muskogee, Okla.

The tie remover above consists of a rail engaging member, a tie engaging member, and means co-operating with the rail engaging member and directed thereby into engagement with the tie engaging member for moving the latter in either direction for the purpose of forcing ties out from under a track.

RAIL JOINT.

1,003,423—John A. Bodkin, New York.

A rail joint formed of a rolled member comprising a girder adapted to fit between the base and the head of a rail and a laterally-extending foot flange adapted to overlie the base of the rail, a portion of the foot flange being bent downwardly to form a truss along one edge of the rail base and adjacent portions of the foot flange being bent inwardly to underlie and engage with the underside of the rail base. The foot flange has a rib extending along its free edge so as to form a stiffening member along the edge of the truss and also rail-supporting members on the portions of the foot flange which are bent inwardly.

RAILWAY TIE.

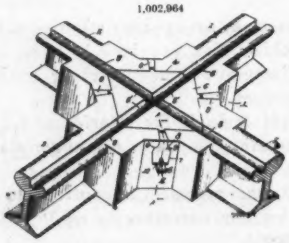
1,000,553—Edwin T. Wade, Seminary, Miss.

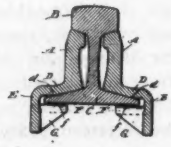
This device is a railroad tie including a plastic body and a core arranged on edge within the body and extending longitudinally thereof. The core has enlargements formed with threaded openings extending through the core, the edges of the core being flush with the corresponding faces of the body; rail fasteners including threaded stems are provided, insertible into the openings, with rail engaging heads upon the stems.

RAILWAY TIE.

1,003,707—John W. Clarke, Jr., Provo, Utah.

This railway tie embodies a metal body having chambers at its opposite ends, and traverse sections on the ends of the tie each having a chamber spaced from the first mentioned chamber; also rail supporting blocks mounted in the chambers, and means for securing the blocks in position, whereby a number of spaced rail supports are provided at each end of the tie.





RAILWAY TRACK CONSTRUCTION.

1,003,703—Tom Cachings, assignor to Isaac Bracey, Jackson, Miss.

The combination of the abutting ends of a pair of rails, a tie supporting the same, and a fish plate applied to the web portions of the rails. The fish plates abut against the heads of the rails but not against the bases, and plates are secured to the sides of the tie on each side of the rails. The plates are formed with upward extensions which terminate in lateral wings adapted to fit against the fish plates, the lateral wings being formed with ribs adapted to fit between the lower edges of the fish plates and the bases of the rails.

RAILWAY TIE.

1,003,898—C. G. B. Gunn, Williamsville, Mo.

A railroad tie comprising sections having contiguous ends, a tie bar flexibility connecting the sections and rails mounted on the bar; the bar is bent back upon itself at its extremities to form clamping jaws adapted to engage with the lower flanges of the rails; clamping plates are secured to the tie bar and tie and adapted to engage with the opposite lower flanges of the rails.

COLLAPSIBLE FORM FOR BUILDING CONCRETE TUNNELS.

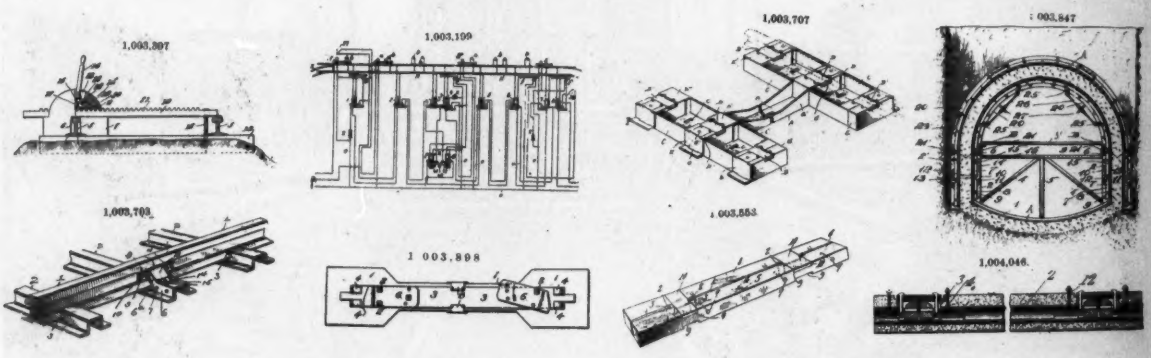
1,003,847—Chas. H. Witthoeft, St. Louis, Mo.

This mold for making concrete tunnels is a combination of a lower stationary vertical mold plate bracing section and mold plates. Track rails are supported by the lower stationary mold plate bracing sections. The mold section comprises an inverted U-shape carrier provided with travelers at its ends, the travelers being ridable upon the track rails.

CONCRETE RAILWAY TIE.

1,004,046—M. A. Lewis, Kellogg, Idaho.

A railway tie including a body, a tubular cushioning member extending longitudinally therein, a core of non-yielding material housed within the member, elastic devices supported by the core, a rail supporting element, and means for exerting a spreading action upon the elastic devices when the element is subjected to a load.



The Chicago, Milwaukee & St. Paul has purchased 185 tons of deck plate girder spans from the Milwaukee Bridge Co., and is said to be in the market for 600 tons additional bridge material.

The Norfolk & Western is making inquiries for 30,000 tons of standard rails for 1912 delivery.

The Spokane, Portland & Seattle is in the market for a large amount of material to be used in the construction of twenty-two bridges, which will be built on its line.

The Canadian Pacific has ordered 1,200 tons of rails from the Illinois Steel Co.

The new high bridge of the Cincinnati, New Orleans & Texas Pacific, over the Kentucky river at High Bridge, was put in service September 11. The bridge spans the gorge of the Kentucky river. It is 31 ft. higher than the old bridge it replaces, and is one of the highest railway bridges in the world. It is 1,230 ft. long and the track level is 308 ft. above low water mark. Over 7,000 tons of steel and 178,500 field rivets were used. The new bridge is designed for double track, and much heavier locomotives can now be used. The increased height is to make easier grades north and south of the bridge.

This Journal has a larger circulation than any other, in the Maintenance of Way Department of the railways of the United States and Canada.

RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

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New Series, Vol. VII
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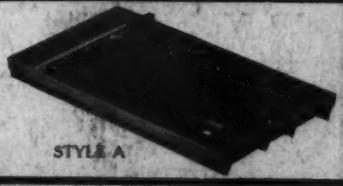
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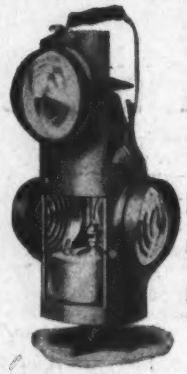

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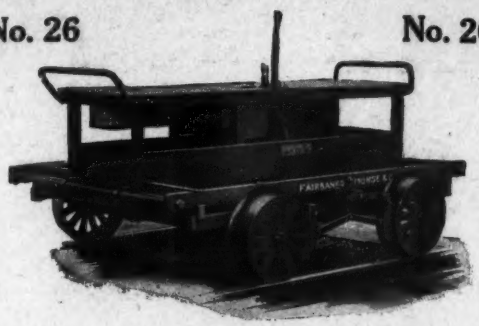

An official of one of the largest and most conservative lines in this country says:

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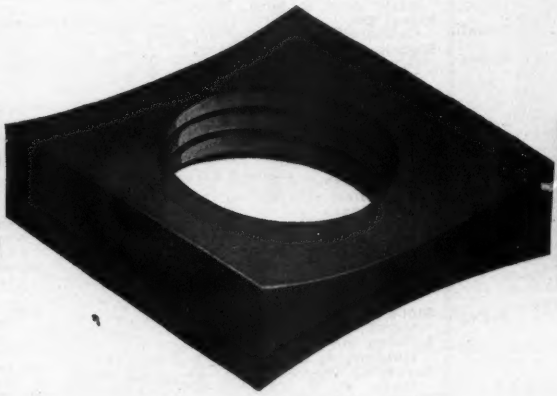
BOSS  NUT

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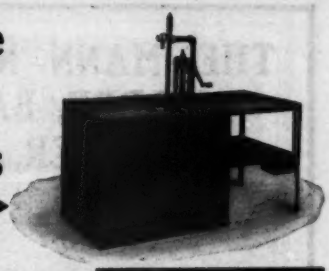

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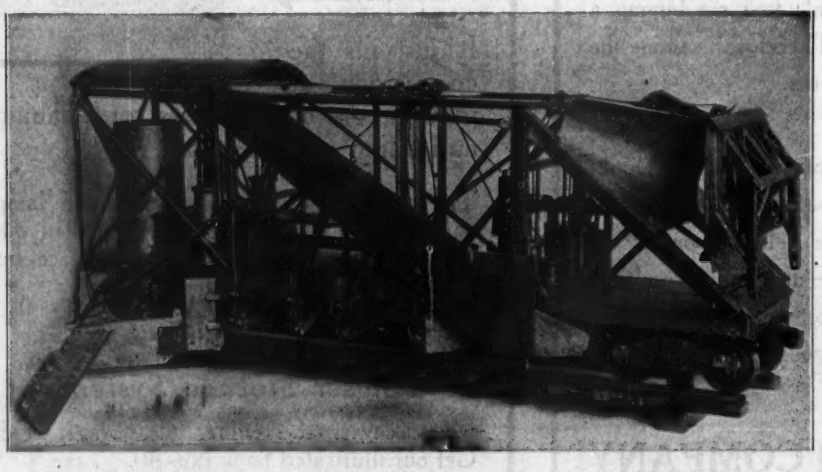

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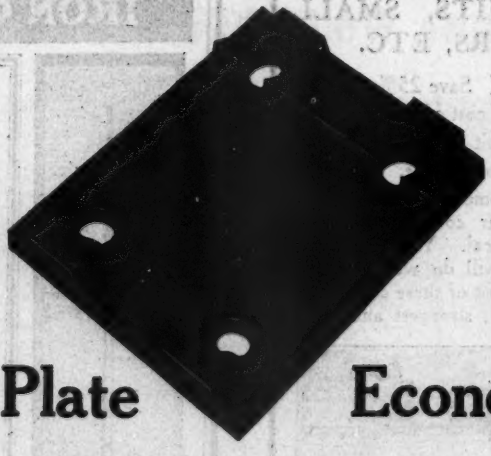

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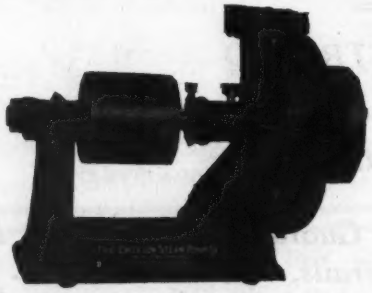

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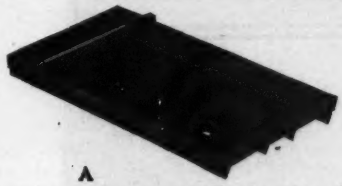
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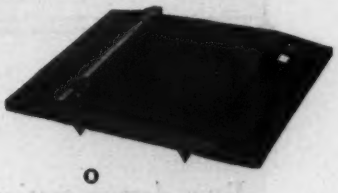
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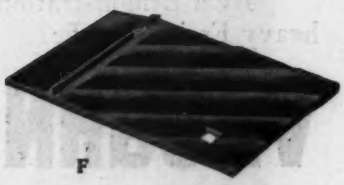
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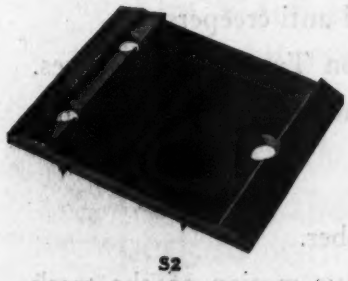
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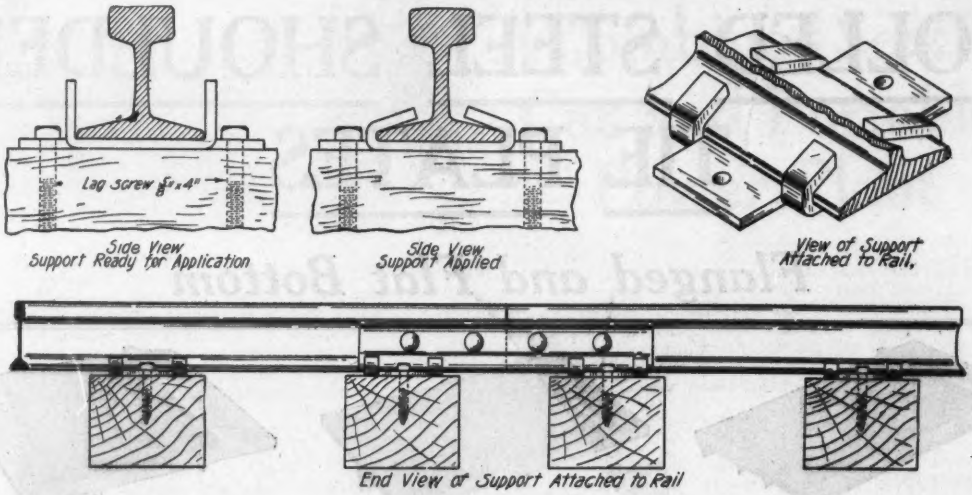

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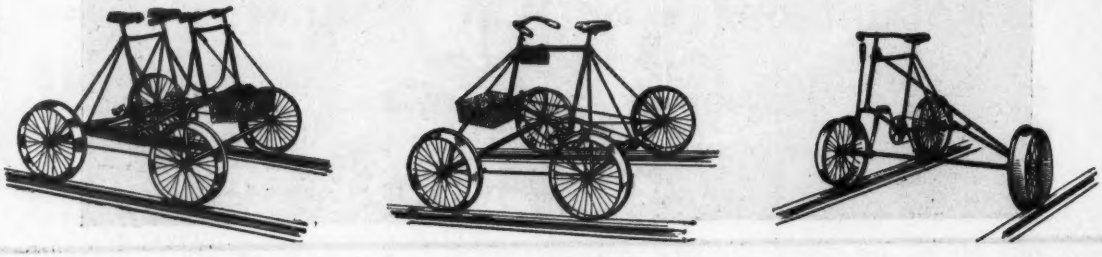

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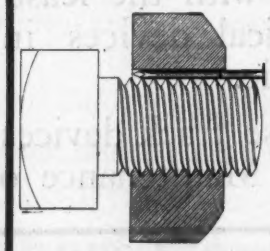

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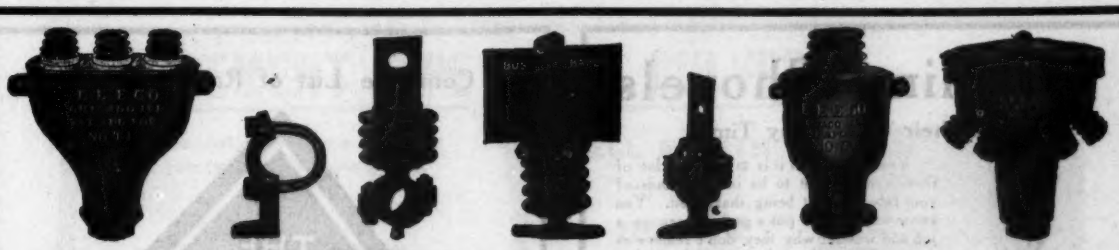

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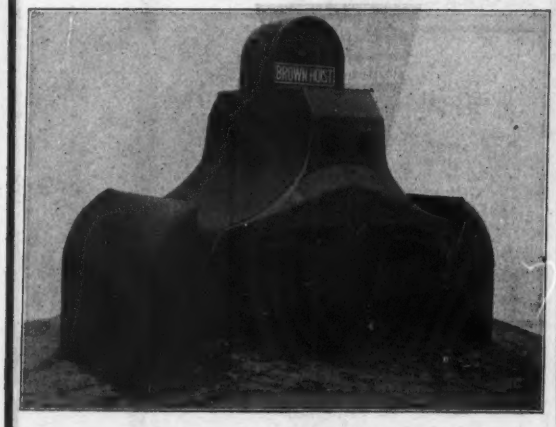

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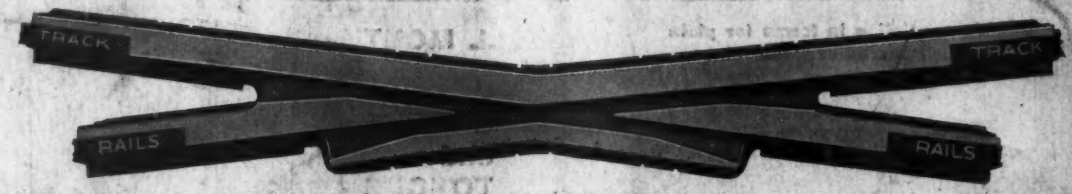

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